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SOILS OF THE MANAWATU DISTRICT.

PART I. THE SAND-DUNES: A POTENTIAL ASSET.

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THE chemical composition of sand-dunes is too often considered to be unworthy of investigation, and dismissed on the assumption that the sand-grains are all quartz (silica), and that, therefore, as soils, dune-sands are permanently poverty-stricken. While this may be so in the majority of countries, it should be borne in mind that there is hardly any limit to the hardness and chemical composition of material which may form sand-dunes or sand-deposits. In the Tularosa Desert, northern Mexico, the moving sand is composed not of silica but gypsum (hydrated calcium sulphate), with a hardness of only 1·5 to 2,* enabling it to be scratched with the finger-nail. At Enderby Island (Auckland Islands) the sand-dunes are composed (as the writer has shown elsewhere) of the remains of sea-animals, the sand being almost pure carbonate of lime, with a probable hardness of 3·5 to 4. Mica, with a hardness of 2 to 3, is a large constituent of Otago sand-dunes. Quartz has a hardness of 7, while garnet, which forms certain sands in Otago, may be even harder than

*The maximum figure in the scale of hardness—*i.e.*, 10—is assigned to diamond.

quartz, and zircon sands are not unknown with a hardness of 7·5. Other siliceous minerals which occur in sands are the feldspars and hornblende. In Carolina occurs monazite sand, largely a phosphatic compound of the rare elements. In the North Island of New Zealand volcanic ejectamenta frequently take the form of sands and form fertile soils. There is therefore no adequate reason for regarding sandy soils as inherently poor in mineral plant-food.

So far from being deficient in mineral plant-food the dune-sands of the Manawatu must be accounted not only rich but very rich in available plant-food. Where the total phosphates are low there is some evidence that this is due to the solvent action of the sea water or spray, and that the high amount of available (or soluble) phosphate is one of the causes of the low amount of insoluble phosphate present. Some surprise has been expressed by certain authors that littoral sand-dunes growing what is considered a halophylous (salt-loving) vegetation contain so little salt, an attitude of mind difficult to reconcile with the fact that salt is soluble in water and the rainfall in most coastal climates of the Temperate Zones would be ample to wash most of the salt from the porous soil and subsoil after deposition. The soil found above the high-tide level on the Waikanae beach has only 0·014 per cent. of salt, while the subsoil (the second 9 in.) contained more than double this—namely, 0·03 per cent. As most farm-crops are able to endure 0·25 per cent. of salt in the soil, and grasses grow well where there is as much as 1 per cent. present (Hall), one would not expect to find any sterility on sandhills caused by salt. It would be in the flat estuarial lands subject to periodical submergence by sea-water that damage would result.

There is considerable evidence to show that the sandhills of the North Island littoral—at least, on the western coast—are richer in mineral plant-food than similar soils of other countries. The statement of the chemical analyses which follows later bears this out with regard to the dune-sands of the Wellington Province, which are estimated to cover an area of not less than 90,000 acres. A belt of dunes extends from Paekakariki to Patea—a distance of 170 miles. From the mouth of the Manawatu River to that of Wangaehu there is an average width of two miles and a half of sand-dune country which is sometimes as much as six miles wide. In the far north of New Zealand there are extensive areas of sand country which in all probability had its origin from land very much to the south, having been transported by the tides and currents. These in New Zealand have a persistent northerly trend, and therefore the northern sand areas may be expected to have a similar composition to similar lands in the south. There is some experimental evidence supporting this, as in 1915 some samples were analysed for the Forestry Branch of the Lands Department (collected by Mr. E. Phillips Turner) which showed a similar composition to those from the Wellington dunes, being well supplied with available phosphoric acid and other mineral plant-food, especially lime (see analysis E 1027).

The necessity of adopting an energetic sand-dune policy at present may be urged under the following heads:—

1. The neglect of wandering dunes or sand in an unstable state is a serious menace to good land already existing on fixed dunes, or even to land which is not dune country but which adjoins it. There

FIG. 1. WAIKANAE BEACH (LOOKING SOUTH).

Barren sand at high tide, and outer foredune with pure association of *Spinifex hirsutus*. Characteristic of soil-samples H 380, H 357, &c.

FIG 2. SAME SPOT AS FIGURE 1, BUT LOOKING NORTH.

Outer foredune and inner foredune, showing the long above-ground stems of Spinifex and the sharp distinction in vegetation of outer and inner foredune. Typical of samples H 357 to K 285. [*Photos, B. C. Aston.*

are numerous instances recorded in geological works of the destructive effect of wandering sand in New Zealand.

2. The "bringing in" of fresh country at the present time is a distinct need when readily accessible land is at such a premium.

3. The inauguration of a Forestry Department at the present time would indicate that the best advice will be available in applying the latest methods of dealing with shifting sands.

4. Large quantities of two classes of soil (humus and sandy) exist side by side, each suffering from exactly that deficiency which the other would supply in order to make a highly fertile soil. The problem of mixing the two is an engineering one, and one which might be expected to receive sympathetic consideration from the Public Works Department.

5. The proximity of much of the dune country to the main arterial roads and railways, the bountiful rainfall, good climate, and long growing season of the North Island coastal districts, and the richness in mineral food of the sand, all conspire to make the reclamation of the dune country not only a fascinating problem, but one which has great possibilities economically.

NOTES ON THE SOILS ANALYSED.

The samples of sand-dune soils analysed and here recorded were all collected by the writer, or under his personal supervision, to a uniform depth of 9 in., with a soil-sampler similar to that recommended by A. D. Hall ("The Soil"), each sample being made up of a number of similar subsamples. The subsoils were taken in a similar way to the depth of a further 9 in. below the soils.

BARREN SANDS.

The samples recorded as H 380–81 in the accompanying tables were collected (12/11/16) on the Waikanae beach (Sec. 36, Blk. V, Kaitawa S.D.) just above spring high-tide level, about 60 ft. on the seaward side from the Spinifex outer foredune.* This is barren of plant-growth, chiefly on account of its mobile character, but also, no doubt, partly on account of the occasional submergence with salt water. The analyses of the soil and subsoil taken in this station are interesting as showing the first stages in the evolution of a fertile soil from recently deposited

* The author recognizes two distinct portions of the foredune—the outer foredune, originally a pure association (silver-grey in colour) of *Spinifex hirsutus*, but now frequently invaded by the naturalized marram-grass (*Ammophila arundinacea*), and with occasional bright-yellow patches of *Scirpus frondosus;* and the inner foredune, which runs parallel with the outer foredune on the landward side of it, and grows a vegetation consisting of *Scirpus frondosus, Coprosma acerosa, Cassinia leptophylla, Scirpus nodosus,* and *Pimelea arenaria, Deyeuxia Billardieri, Spinifex, Arundo conspicua, Sonchus asper, Carex Buchanani, Calystegia Soldanella, Cyathodes acerosa, Leptospermum ericoides,* and the naturalized *Lupinus* sp., *Festuca myurus, Aira caryophyllea, Erigeron canadensis, Trifolium arvense, Hypochaeris radicata, Rumex Acetosella,* and *Silene gallica.* The significance of this note is that it illustrates an example of a well-defined and characterized change of vegetation not connoting any noticeable change in the quality of the soil. The change is probably due to climatic causes—*i.e.*, the inner foredune is protected by the outer foredune from the wind, and is therefore warmer and the soil more stable.

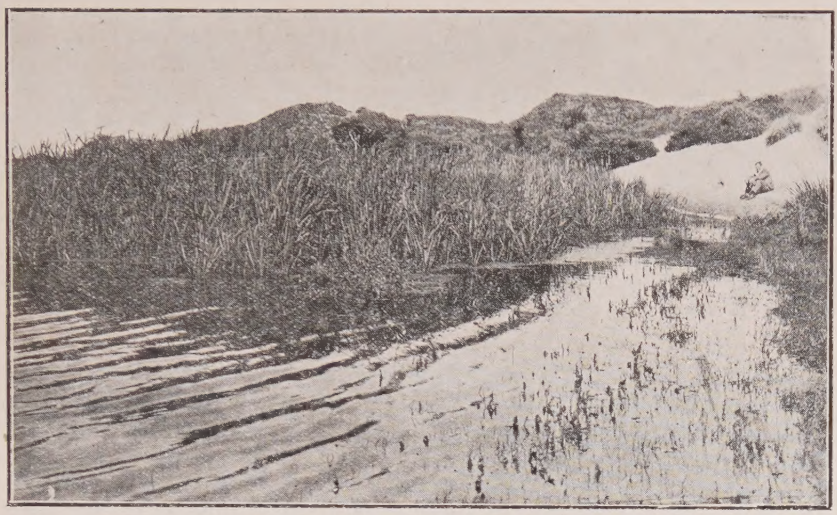


FIG. 3. HUMUS-MAKING RAUPO (TYPHA ANGUSTIFOLIA) SWAMP, WAIKANAE.
Showing the semi-stabilized dunes being converted into good land by swamp-plants.

FIG. 4. SEMI-STABILIZED DUNE, WAIKANAE, BEING FIXED BY LUPINS AND WILD CONVOLVULUS (CALYSTEGIA SOLDANELLA). [*Photos, B. C. Aston.*

mineral matter. A noteworthy fact is the comparatively high amount of mineral plant-food present in an available (citric-acid soluble) condition. The total amount of plant-food extracted by hydrochloric acid is also high. The presence of carbonate of lime, which this and the foredune soils contain, marks these two soils off sharply from the more stable dune-soils lying to the landward. The loss of weight on ignition to redness representing organic matter and combined water is, of course, small, showing, as one would expect, a great deficiency in exactly that constituent necessary to convert the sand into a fertile soil. The improvement of the moving sand into a fertile soil as the sea recedes* therefore depends, after its fixation into a stabilized dune, largely on the amount of organic matter which can be introduced into it by the action of successive forms of plant-life.

FOREDUNES.

The sample H 357 was taken (12/11/16) on a 300-yards frontage in a pure association of Spinifex on the outer foredune at Waikanae beach—a natural rampart of sand which stretches for many miles north and south from the spot where the samples and photographs were taken. The photos show very well the pure association of Spinifex on the outer foredune (Sec. 36, Blk. V, Kaitawa S.D.). H 382 was taken (12/11/16) in the inner part of the foredune in a mixed association of *Coprosma acerosa* and many other plants (see footnote on page 276), immediately adjacent on the landward side to the area sampled in H 357 (Sec. 36, Blk. V, Kaitawa S.D.). H 625 was taken (3/3/17) at Levin beach over half a mile of frontage amongst a pure Spinifex association on the foredune comparable with H 357 (Sec. B42, Blk. IV, Moutere S.D.). J 104 was taken (28/4/17) from coastal dunes on the Foxton beach within half a mile of the sea on a wandering dune, the only vegetation (discontinuous) being *Scirpus frondosus*, marram-grass, and Spinifex (Blk. IV, Sandy S.D.). K 283, taken (25/8/18) from Levin outer foredune, about 20 ft. above high water, in a pure association of Spinifex, with occasional clumps of marram. This foredune is similar to that at Waikanae beach, but much higher, and extending north and south in an unbroken line as far as the eye can reach. A difference between this and the Waikanae is that there is no well-defined inner foredune as at Waikanae (Sec. 1, Blk. III, Moutere S.D.). K 285 was taken (25/8/18) on inner wandering dunes near Levin, 40 ft. above sea; vegetation, *Scirpus frondosus, Cassinia leptophylla, Pimelea arenaria, Leptospermum scoparium, Leptocarpus simplex, Deyeuxia Billardieri, Spinifex hirsutus, Arundo conspicua* (Sec. 1, Blk. III, Moutere S.D.). K 366 was taken (21/9/18) from an outer foredune at Paraparaumu, growing vegetation consisting chiefly of marram-grass, but also mixed with Spinifex and *Scirpus frondosus* (Blk. III, Kapiti S.D.). K 368 was taken (21/9/18) from an inner foredune at Paraparaumu, growing Spinifex, *Scirpus nodosus, Coprosma acerosa, Cassinia leptophylla, Pteris esculenta, Pimelea arenaria, Deyeuxia Billardieri, Hypochaeris radicata, Carex comans* or *Buchanani* (Blk. III, Kapiti).

* The sea is receding all along the coast. The encroachment of land into the sea roughly measured by the present owner (a surveyor) of some miles of sea frontage, as the result of some thirty years' experience, is estimated by him as being one chain in ten years.

As one would expect, there is little difference between the composition of barren sand and that of the foredune. It is only plants which are specially adapted to survive on a moving sand by the quick production of underground and above-ground stems of enormous length that can hope to survive on a moving soil, the direction of the motion of which may vary with the direction of wind, resulting possibly in the uncovering of entire plants. Such a vegetation is not calculated to increase the organic matter in the soil, the portion decaying above ground being more easily blown away than buried, while the portion below ground stretches through such a depth of soil that it would not appreciably affect the composition of the top 9 in. from which the samples are collected. Hence the amount of the organic matter of the foredune is not appreciably greater than that of the barren sand

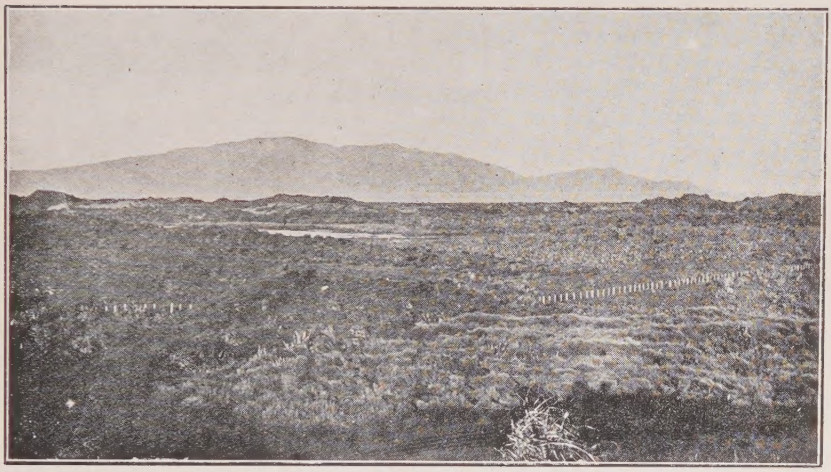


FIG. 5. SEMI-STABILIZED AND STABILIZED DUNES—THE LATTER EITHER PASTURE OR DUNE HEATH.

Kapiti Island in the distance.

alongside, and the same is true of the nitrogen-content. The comparatively large amount of salt (soluble chlorides) in the sand nearest the sea should be noted. Regarding the phosphoric-acid content of this series of sands, it will be seen that the coarser the soil the higher the percentage of available phosphate. Generally speaking, where the sand has been mixed with finer material—silt or clay—derived probably from a different source from that from which the sand originated (the sand probably progressing inland by the aid of the sea and the sea-winds, while the silt and clay are progressing seaward by the aid mainly of rivers and floods),* the percentage of available phosphate is at once lowered. Usually, the nearer the sea the more available phosphate there is in the sand. This may be due to the action of the salts

* An alternative theory is that the finer particles are blown farther from the sea, and hence the sand farthest from the sea should contain the finest particles.

of the sea-water acting on the insoluble phosphate and making it available or soluble. The high amount of available phosphate compared with the total quantity present in areas near the sea has been noticed by the writer before (see articles in this *Journal*, "The Hauraki Plains," June, 1914, and "Some Typical Nelson Soils," August, 1919). It is a fact particularly conspicuous in these littoral sandy soils, and suggests that the high availability may be only a stage in the attack—the solution and the subsequent removal of the phosphate by a leaching action by salt water. The latter contains sodium and magnesium chlorides, and these salts by reacting with the silicates, phosphates, and carbonates of the soil may render possible the removal of phosphates from the top soil by leaching, which rarely occurs in nature. In connection with the interaction of phosphates with chlorides it is significant to note the occurrence* at Cape Cross, South-west Africa, of a mixture of phosphates and chlorides of sodium and magnesium recently recorded, in which mixture two-thirds of the phosphate was present as soluble in weak citric acid or "available." The reaction may be a slow one, but it is certainly worth experimenting with from a commercial point of view to ascertain whether any improvement in availability of insoluble phosphates can be effected by mixing with cheap chlorides or sea-salts.

STABILIZED DUNES.

Sample H 359 was taken (4/11/16) in a dune heath near the Waikanae beach (Sec. 36, Blk. V, Kaitawa S.D.). H 374 was taken (12/11/16) on a grassed dune on the highest sandhill near Waikanae, on land never ploughed, but covered with a vegetation of sweet vernal, rye-grass, *Microlaena*, &c. (Sec. 38, Blk. V, Kaitawa S.D.). H 377 was taken (12/11/16) in a grass-dune paddock at Waikanae, which has been ploughed, the pasture consisting of *Festuca myurus* and other poor grasses (Sec. 37, Blk. V, Kaitawa S.D.). H 627 was taken (3/3/17) half a mile from the sea, at Levin beach, in a dune heath of *Leptospermum ericoides* (tall manuka), *Pteris esculenta* (bracken-fern), *Arundo* (toetoe), *Cassinia leptophylla* (tauhinu), *Leucopogon Fraseri*, and *Microlaena* (B42, Blk. IV, Moutere S.D.). J 114 was taken (29/4/17) from a grassed dune near Paekakariki Railway-station, above the golf-links, the pasture being chiefly *Sporobolus indicus* (ratstail), *Microlaena*, and English pasture grasses (Sec. 52, Blk. III, Paekakariki S.D.). J 164 was taken (12/5/17) in flat sandy land (dune plain) inside the dunes at Otaki beach, near the sea; vegetation, *Mariscus*, *Juncus*, *Carex*, mixed with tall fescue and English pasture grasses (Blk. VI, Waitohu S.D.). K 287 was taken (25/8/18) in the first dune plain inside the broken dunes at Levin beach; vegetation, closed sward of *Danthonia pilosa*, with *Poa pratensis*, containing also *Arundo*, *Juncus effusus*, *Mariscus*, *Festuca bromoides*, and *Acaena*, sorrel, Yorkshire fog, and *Geranium molle* (Sec. 1, Blk. III, Moutere S.D.). K 289, Levin–Foxton Road dunes, was taken (25/8/18) from the second row of semi-stabilized dunes, containing very little Danthonia, the grass covering being not at all good; vegetation chiefly *Scirpus frondosus*, *Coprosma acerosa*, *Arundo*, *Cassinia leptophylla* Yorkshire fog, *Carex Buchanani*, *Pimelea arenaria*, *Leucopogon Fraseri*, *Lupinus arboreus*, *Carmichaelia*, *Discaria*,

* Report of Agricultural Research Chemist, Union of South Africa: Appendix XI, c. 19, 1918, page 5.

marram-grass, bracken, *Muehlenbeckia complexa, Trifolium arvense,* and *Trifolium glomeratum.* This series of inner dunes is badly affected by the wind, and is at an elevation of about 90 ft. above sea (Sec. 1, Blk. III, Moutere S.D.). K 383 was taken (25/8/18) from a grassed dune near Te Horo, adjacent to white-pine forest; vegetation, *Microlaena* and English pasture grasses (Blk. II, Kaitawa S.D.).

The most striking difference in the composition of the stabilized dunes compared with the foredunes is the increase in the amount of matter lost on ignition (organic matter) and in the total nitrogen. It will be noticed that the samples grouped under the term "stabilized dunes" are themselves divisible into two other divisions—the dune heaths and the dune pastures. The former, coming immediately after the foredunes, are usually nearer the sea than the pastures. The dune heath has usually less organic matter and nitrogen than the dune pasture. The amount of available phosphoric acid in these samples is still very high. The carbonate of lime—as one would expect from the rapid leaching to which these dunes are subject—has disappeared. The total calcium has also accordingly diminished, and coincident with this decrease is an increase in the figure for "lime-requirement," which now becomes a positive quantity, though a small one. The high availability in phosphates of some of these soils is quite striking compared with the total amount of phosphate.

STABILIZED SILTY SAND-DUNES.

Sample H 386 was taken (12/11/16) in dune pasture near swampy forest far from sea, Waikanae, in good English grasses (Sec. 45, Blk. V, Kaitawa S.D.). H 407 was taken (23/11/16) in dune pasture, far from sea ("Telegraph Paddock"), Waikanae, in poor English grasses, *Festuca myurus,* mixed with *Danthonia semiannularis* and *Microlaena stipoides* (Sec. 37, Blk. IV, Kaitawa S.D.). J 102 was taken (8/4/17) from dune pasture on the Longburn–Foxton Road, ten miles and a half from Longburn; a reddish sandy soil with some humus on top. J 106 was taken (29/4/17) in dune pasture near the Manawatu Bridge, Foxton, the vegetation consisting of English pasture grasses, *Microlaena,* and *Scirpus nodosus;* soil black to brown in colour (Blk. IX, Moutere S.D.). J 108 was taken (29/4/17) on dune pasture at Big Trig. Hill (180 ft.), Levin, immediately west of Horowhenua Lake; vegetation, English pasture grasses and *Microlaena* (Blk. IV, Moutere S.D.). J 110 was taken (28/4/17) in pasture dunes near Big Trig. Hill, Moutere, Levin. This area gives evidence in the mechanical analysis of considerable mixture of silt with the sand, and therefore the dune sands have probably been mixed with detritus brought down by floods (Blk. IV, Moutere S.D.). J 169 was taken (12/5/17) in bracken association in the Telegraph Paddock, near where H 407 was taken. K 251 was taken (19/8/18) in pasture sand-valley; vegetation, *Danthonia pilosa* sward, with little *Microlaena* and *Trifolium arvense* in good close sward; soil black to depth of 9 in.; situated about a mile from Levin beach. K 253 was taken (19/8/18) near MacDonald's woolshed, on parallel dune on Levin–Foxton Road (Sec. 4, Blk. XIII, Mt. Robinson S.D.); vegetation, sward of *Danthonia pilosa.* K 291 was taken (28/8/18) in the third line of sand-dunes running at right angles to the coast. This is the first really stable sandy land met with in proceeding inland from the

coast in the area south of the Manawatu River mouth. The sample was collected on one of the remarkable long parallel dunes so characteristic of this area. Vegetation consists of a close sward of *Poa pratensis, Microlaena stipoides, Danthonia pilosa,* and *Trifolium minor,* and a conspicuous native plant dotted about is *Scirpus nodosus.* A black sandy soil; 95 ft. above sea-level (Sec. 1, Blk. III, Moutere S.D.). K 370 was taken (21/9/18) from dune pasture, a black sandy soil, about half a mile from the beach at Paraparaumu; vegetation, pasture grasses and *Mariscus* (Blk. III, Kapiti S.D.). L 139 was taken (15/6/19) in pasture dune on Laurie's farm, at Te Horo; vegetation, *Danthonia* and English pasture grasses in close sward (Blk. II, Kaitawa S.D.). L 429 was taken (20/9/19) in pasture dune near Phillips's farm, Paekakariki; vegetation, close sward of *Danthonia* and English pasture grasses (Blk. II, Kapiti S.D.).

The remarkable point about these dunes is the admixture of silt, fine silt, and in some cases a trace of clay. All the previous samples noticed contained from 80 to 98 per cent. of coarse and fine sand mixed with varying amounts of organic matter, and only traces of silts. Now, as one progresses away from the sea the dunes commence to show traces of the finer-sized fractions of mineral matter, which, by improving the mechanical state of the soil and by decreasing the excessive porosity and instability when dry, tends to remove those disabilities from which all sandy soils suffer. It will be noted that the average nitrogen is slightly higher, but the most marked chemical difference is the fall in the amount of available phosphoric acid compared with that in the sand-dunes. The average in the sand-dunes is 0·031 per cent., but in the silty sands only 0·0125 per cent. There is not much difference in the amounts of the other constituents, but the lime-requirement figure shows a decided average increase in the silty sands.

FOREST DUNES.

H 355 was taken (4/11/16) on a forest dune, Waikanae, near the railway-station (Blk. VI, Kaitawa S.D.). K 249 was taken (20/8/18) in a forest dune, Waikanae, nearer the sea than H 355. Vegetation: Forest—*Dysoxylum spectabile, Beilschmiedia Tawa, Knightia excelsa, Myrsine Urvillei, Melicytus ramiflorus, Alectryon excelsum, Corynocarpus laevigata.* Underscrub — *Melicope ternata, Cyathea dealbata, C. medullaris, Dicksonia squarrosa, Pteris tremulentum, P. incisa, Pittosporum tenuifolium.* Epiphytes—*Freycinetia, Griselinia lucida, Astelia Solandri, Pittosporum cornifolium,* and *Metrosideros scandens.*

The dune forest marks the highest point in the evolution of the sand-dunes natural covering. The soils are only slightly mixed with silt, but, as one would expect, the loss on ignition is high, due to the larger amount of organic matter of humus which is present, owing to the permanent covering of vegetation and the continuous dropping of dead leaves and vegetable remains.

OTHER SANDS.

E 976–1–2 and E 1027 were samples collected by the Forestry Officer, received from the Lands Department in August, 1914, with a request to ascertain the capacity of the land for carrying plant-growth. E 976–1–2 were collected from Rangitikei dunes, and E 1027 from the dunes at the mouth of the Waikato River.

FIG. 6. DUNE FOREST, WAIKANAE.

New Zealand mahogany (*Dysoxylum spectabile*), which is sometimes 11 ft. in circumference, is the chief component of this forest. Also are present *Knightia* and *Pseudopanax*. The camera-case against mahogany-tree in centre shows the scale. Characteristic of samples H 355 and K 249. [*Photo, B. C. Aston.*

MANAWATU DISTRICT SAND-DUNE SOILS.—CHEMICAL ANALYSES.

Results except * are percentages on soil dried at 100° C.

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-Cent. Citric-acid Extract, Dyer's Method; Hall's Modification ("Available" Plant-food).				Hydrochloric-acid Extract ("Total" Plant-food).				Lime-requirement (Percentage $CaCO_3$).		Chlorine = Sodium Chloride (Salt) NaCl.	Carbon Dioxide = Calcium Carbonate $CaCO_3$
		*On Air-drying.	*At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5	Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5	On Air-dried Soil.	On Soil dried at 100° C.		
	Sterile Sands.																
H 380	Waikanae beach	6·0	0·046	0·54	0·040	..	..	0·037	0·027	1·25	0·66	0·19	0·23	— 0·03	— 0·03	0·014	0·18
H 381	Subsoil of H 380	7·0	Trace	0·87	0·028	..	..	0·023	0·027	1·04	0·72	0·08	0·16	— 0·03	— 0·03	0·033	0·10
	Foredunes.																
H 357	Outer foredune, Waikanae	5·0	0·270	0·81	0·042	..	..	0·027	0·031	1·16	0·66	0·07	0·09	— 0·01	— 0·01	0·004	0·16
H 382	Inner foredune, Waikanae	4·0	0·208	0·56	0·051	..	..	0·011	0·024	1·01	0·66	0·08	0·07	Nil	Nil	0·002	..
H 625	Outer dune, Levin	..	0·260	0·44	0·028	..	..	0·010	0·018	1·26	0·46	0·07	0·09	— 0·02	— 0·02	..	0·48
J 104	Shifting dune, Foxton	17·0	0·310	0·84	0·028	..	..	0·008	0·014	0·93	0·20	0·14	0·10	— 0·02	— 0·02	..	0·34
K 283	Outer foredune, Levin	2·9	0·28	0·66	0·036	0·175	0·050	0·024	0·036	1·59	0·56	0·24	0·05	— 0·03	— 0·03	..	..
K 285	Inner foredune, Levin	1·3	0·24	0·62	0·014	0·108	0·032	0·022	0·057	1·74	0·67	0·25	0·08	— 0·02	— 0·02	..	..
K 366	Outer foredune, Paraparaumu	5·9	0·36	0·94	0·023	0·288	0·047	0·023	0·021	1·53	0·43	0·26	0·06	— 0·02	— 0·02	..	..
K 368	Inner foredune, Paraparaumu	14·3	0·46	0·12	0·031	0·125	0·033	0·024	0·029	1·33	0·43	0·26	0·07	— 0·02	— 0·02	..	..
	Subsoils of Foredunes.																
H 358	Subsoil of H 357	4·0	0·300	0·92	0·056	..	..	0·026	0·032	1·22	0·68	0·06	0·09	— 0·03	— 0·03	0·002	0·07
H 383	Subsoil of H 382	5·0	Trace	0·62	0·056	..	..	0·011	0·035	0·98	0·67	0·10	0·06	Nil	Nil	0·002	..
H 626	Subsoil of H 625	..	0·34	0·54	0·028	..	..	0·006	0·013	1·11	0·57	0·04	0·08	— 0·02	— 0·02	..	0·40
J 105	Subsoil of J 104	21·0	0·33	0·71	0·048	..	..	0·007	0·018	0·86	0·44	0·11	0·11	— 0·02	— 0·02	..	0·34
	Stabilized Dunes.																
H 359	Near sea, in dune heath, Waikanae	10·0	0·69	1·62	0·084	..	..	0·005	0·035	1·31	0·58	0·03	0·14	0·02	0·02	0·001	..
H 374	About one mile from sea, in dune pasture, Waikanae	5·0	1·66	5·10	0·149	..	..	0·010	0·036	0·91	0·64	0·07	0·10	0·07	0·07	0·004	..
H 377	About one mile from sea, in dune pasture, Waikanae	8·0	1·56	2·19	0·160	..	..	0·010	0·052	0·82	0·55	0·11	0·19	0·11	0·11	0·005	..
H 627	Manuka dune heath, half-mile from sea, Levin	..	3·26	2·89	0·080	..	..	0·009	0·032	0·95	0·46	0·07	0·11	0·06	0·06	..	..
J 114	Dune pasture, Paekakariki	7·0	4·76	6·75	0·209	..	..	0·012	0·018	0·94	0·21	0·14	0·10	0·14	0·15	..	..
J 164	Wet sand plain, inside dunes, Otaki	14·0	2·56	6·87	0·211	..	..	0·031	0·018	0·74	0·45	0·12	0·07	0·12	0·12	..	..
J 353	Dune, Foxton	..	Nil	1·79	0·050	..	..	0·008	0·041	0·97	0·21	0·08	0·07	..	..	..	..
K 287	Dune heath pasture, Levin	5·2	1·10	6·89	0·105	0·157	0·041	0·025	0·039	1·73	0·67	0·26	0·08	0·01	0·01	..	..
K 289	Dune heath pasture, Levin	18·5	0·64	6·80	0·079	..	..	0·023	0·041	1·70	0·66	0·25	0·08	0·02	0·02	..	..
K 383	Dune pasture, Te Horo	15·4	3·38	5·81	0·205	0·098	0·020	0·027	0·011	1·41	0·41	0·24	0·07	0·12	0·12	..	..

	Subsoils of Stabilized Dunes.																
H 360	Subsoil of H 359	5·0	0·30	1·11	0·034	..	..	0·006	0·032	1·31	0·65	0·06	0·09	0·01	0·01	0·001	..
H 375	Subsoil of H 374	6·0	0·39	1·95	0·109	..	..	0·008	0·042	0·91	0·63	0·12	0·09	0·09	0·09	0·002	..
H 378	Subsoil of H 377	6·0	0·86	2·19	0·070	..	..	0·012	0·018	1·13	0·62	0·21	0·21	0·02	0·02	0·003	..
H 628	Subsoil of H 627	..	0·05	1·83	0·053	..	..	0·013	0·029	0·90	0·60	0·07	0·12	0·02	0·02	..	..
J 115	Subsoil of J 114	11·0	2·83	3·32	0·110	..	..	0·006	0·018	0·96	0·23	0·14	0·09	0·05	0·05	.	..
J 165	Subsoil of J 164	4·0	1·51	3·80	0·087	..	..	0·015	0·024	0·78	0·58	0·14	0·08	0·05	0·05	..	..
J 354	Subsoil of J 353	..	0·49	0·73	0·020	..	..	0·009	0·041	0·78	0·24	0·12	0·06	..	..	..	..
	Stabilized Silty Sand-dunes.																
H 386	Dune pasture, Waikanae ..	15·0	4·90	4·33	0·118	..	..	0·013	0·016	0·91	0·58	0·18	0·11	0·15	0·16	0·007	..
H 407	Dune pasture, Waikanae ..	14·0	0·73	4·51	0·112	..	..	0·026	0·023	1·30	0·50	0·26	0·08	0·14	0·14	..	..
J 102	Dune pasture, Longburn–Foxton Road	14·0	5·16	5·47	0·219	..	..	0·017	0·016	1·01	0·26	0·14	0·13	— 0·03	— 0·03	..	..
J 106	Dune pasture, Foxton Road ..	9·0	5·90	6·01	0·211	..	..	0·017	0·009	1·14	0·46	0·15	0·05	0·10	0·11	..	..
J 108	Dune pasture, Trig. Hill, Levin	10·0	4·89	6·11	0·218	..	..	0·022	0·009	1·12	0·28	0·09	0·06	0·13	0·14	..	..
J 110	Dune pasture, near Trig. Hill, Levin	10·0	4·91	5·57	0·180	..	..	0·017	0·005	0·97	0·80	0·13	0·07	0·15	0·16	..	..
J 169	Dune pasture, Waikanae ..	9·0	2·54	6·51	0·210	..	..	0·022	0·013	0·79	0·46	0·14	0·08	0·18	0·18	..	..
K 251	Dune pasture, Foxton Road ..	..	2·62	5·22	0·242	0·113	0·035	0·030	0·010	1·22	0·61	0·31	0·05	0·11	0·1	..	..
K 253	Dune pasture, Foxton Road ..	..	3·80	6·20	0·233	0·145	0·035	0·031	0·019	1·33	0·50	0·26	0·28	0·10	0·10	..	..
K 291	Dune pasture, Foxton Road ..	10·0	3·02	6·33	0·225	0·156	0·046	0·022	0·010	1·36	0·57	0·28	0·07	0·09	0·09	.	..
K 370	Dune pasture, Paraparaumu ..	22·6	2·92	8·77	0·317	0·150	0·037	0·032	0·009	1·30	0·35	0·24	0·04	0·20	0·20	..	..
L 139	Dune pasture, Te Horo ..	8·0	2·42	6·10	0·205	0·123	0·039	0·028	0·012	..	..	..	..	0·18	0·18	..	
L 429	Dune pasture, Paekakariki ..	24·6	3·58	8·84	0·276	0·172	0·061	0·021	0·011	1·15	0·37	0·20	0·07	0·19	0·20	..	..
	Subsoils of Stabilized Silty Sand-dunes.																
H 387	Subsoil of H 386	10·0	2·26	3·67	0·058	..	..	0·009	0·015	0·91	0·52	0·15	0·08	0·06	0·06	0·004	..
H 408	Subsoil of H 407	12·0	1·82	2·57	0·086	..	..	0·021	0·026	0·91	0·34	0·21	0·06	0·06	0·06	..	..
J 103	Subsoil of J 102	7·0	1·48	1·61	0·063	..	..	0·011	0·028	0·90	0·25	0·10	0·11	— 0·01	— 0·01	..	..
J 107	Subsoil of J 106	10·0	3·08	3·54	0·098	..	..	0·012	0·008	0·71	0·15	0·08	0·10	0·04	0·04	..	..
J 109	Subsoil of J 108	7·0	2·13	3·40	0·098	..	..	0·024	0·006	1·06	0·30	0·12	0·05	0·05	0·05	..	..
J 111	Subsoil of J 110	7·0	1·75	2·29	0·080	..	..	0·005	0·004	1·00	0·35	0·09	0·07	0·05	0·05	..	..
J 170	Subsoil of J 169	4·0	1·69	3·77	0·081	..	..	0·008	0·014	1·02	0·33	0·14	0·08	0·08	0·08	..	..
	Dune Forest.																
H 355	Dune forest, Waikanae ..	10·87	5·49	5·47	0·190	..	..	0·009	0·009	1·19	0·38	0·21	0·09	0·07	0·07	0·010	..
K 249	Dune forest, Waikanae ..	..	2·72	8·45	..	0·258	0·094	0·033	0·010	1·48	0·60	0·33	0·16	..	..	..	..
	Subsoil of Dune Forest.																
H 356	Subsoil of H 355	9·0	1·87	3·15	0·115	..	..	0·004	0·012	1·32	0·499	0·04	0·07	0·08	0·08	0·008	..
	Other Sands.																
E 976–1	Sand from Rangitikei dunes ..	..	0·08	0·35	..	..	..	0·014	0·031	1·58	0·54	0·15	0·06	.	.	.	..
E 976–2	Sand from Rangitikei dunes ..	..	0·14	0·44	..	..	..	0·012	0·031	1·52	0·49	0·19	0·06	..	..	..	..
E 1027	Sand from Waikato Heads ..	..	0·20	0·33	..	..	..	0·013	0·012	1·99	0·74	0·09	0·05	..	..	..	..

NOTE. The minus sign before "lime-requirement" figures indicates that the soil gives up lime, instead of absorbing it, when shaken with a solution of calcium bicarbonate. Hutchinson and MacLennan method used.

MANAWATU DISTRICT SAND-DUNE SOILS.—MECHANICAL ANALYSES.

Results are percentages on air-dried soil.

Lab. No.	Description of Soil. (Classification of U.S. Department of Agriculture, modified.)	Analysis of "Fine Earth" passing 2 mm. Sieve.						Stones and Gravel.
		Fine Gravel.	Coarse and Fine Sand.	Silt.	Fine Silt.	Clay.	Moisture and Loss on Ignition.	
H 380	Sterile sand	Nil	97·7	0·1	Nil	Nil	0·6	..
H 381	,,	,,	97·7	0·1	,,	,,	0·9	..
H 357	Foredune	,,	98·4	0·1	0·1	,,	1·1	
H 382	,,	,,	97·9	0·6	Nil	,,	0·8	..
H 625	,,	,,	97·7	0·1	Trace	,,	0·7	..
J 104	,,	,,	98·1	..	..	..	1·2	..
K 283	,,	,,	98·7	Nil	Nil	Nil	0·9	..
K 285	,,	,,	98·3	,,	,,	,,	0·9	..
K 366	,,	,,	97·3	,,	,,	,,	0·5	..
K 368	,,	,,	97·4	,,	,,	,,	1·7	..
H 358	Subsoils of foredunes	,,	98·5	0·2	Trace	,,	0·7	..
H 383	,,	,,	97·6	0·1	Nil	,,	0·9	..
H 626	,,	,,	97·1	0·1	,,	,,	0·9	..
J 105	,,	,,	97·4	Nil	,,	,,	1·1	..
H 359	Stabilized dunes	,,	96·5	0·5	0·1	,,	2·3	..
H 374	,,	,,	90·3	1·4	0·2	,,	6·8	..
H 377	,,	,,	92·2	2·4	0·2	,,	3·7	..
H 627	,,	,,	93·8	1·9	0·2	,,	3·3	..
J 114	,,	,,	85·0	2·2	0·1	,,	11·7	..
J 164	,,	,,	83·6	2·3	0·2	,,	9·4	..
J 353	,,	,,	95·5	0·8	0·3	,,	2·1	..
K 287	,,	,,	91·0	1·3	0·8	,,	7·9	..
K 289	,,	,,	93·0	0·4	Nil	,,	7·4	..
K 383	,,	,,	82·3	4·9	3·1	Trace	9·0	..
H 360	Subsoils of stabilized dunes	,,	98·8	0·2	Trace	,,	1·4	..
H 375	,,	,,	95·6	0·8	0·1	,,	2·1	..
H 378	,,	,,	95·1	0·8	0·1	,,	3·0	..
H 628	,,	,,	95·6	0·9	0·1	,,	1·5	..
J 115	,,	,,	88·4	2·9	0·1	,,	6·2	..
J 165	,,	,,	83·5	5·7	1·1	,,	5·5	..
J 354	,,	,,	97·0	0·5	0·2	,,	0·8	..
H 386	Stabilized silty sand-dunes	,,	78·9	7·3	1·5	,,	9·4	..
H 407	,,	,,	83·8	5·5	3·0	0·1	5·3	..
J 102	,,	,,	83·1	3·2	1·1	Nil	10·8	..
J 106	,,	,,	81·1	4·8	1·2	,,	12·1	..
J 108	,,	,,	77·6	8·0	1·0	0·1	11·1	..
J 110	,,	,,	75·5	8·0	1·9	0·1	10·6	..
J 169	,,	4·0	84·6	3·1	0·6	..	9·2	4·0
K 251	)							
K 253	,,	Nil	80·0	5·9	3·3	Nil	9·2	..
K 291	)							
K 370	,,	,,	74·4	6·9	4·5	0·7	..	..
L 139	,,	,,	80·4	5·4	2·4	0·3	9·3	..
L 429	,,	,,	74·0	7·5	3·5	2·6	12·1	..
H 387	Subsoils of stabilized silty sand-dunes	,,	85·6	4·8	0·1	Nil	5·9	..
H 408	Ditto	,,	88·1	0·8	0·2	0·1	4·4	..
J 103	,,	,,	95·1	0·2	0·1	Nil	3·1	..
J 107	,,	,,	85·6	4·9	1·6	,,	6·7	..
J 109	,,	,,	81·1	8·0	2·2	0·2	5·9	..
J 111	,,	,,	90·2	2·9	0·5	Nil	4·1	..
J 179	,,	1·6	90·7	2·3	0·1	,,	5·5	1·6
H 355	Dune forest	Nil	83·2	3·9	Nil	,,	11·4	..
K 249	,,	,,	71·5	7·3	6·6	2·8	11·0	..
H 356	Subsoil of dune forest	,,	88·7	3·0	0·3	Nil	5·3	..

(To be continued.)

Farrowing of Pigs.—Farmers may be reminded that a fender or rail in the farrowing-pen is often the means of saving the lives of little pigs. A simple method is to place a 2 in. by 4 in. or 2 in. by 6 in. piece of timber about 8 in. above the floor of the pen, nailed firmly to the wall. The sow's body may go up against the side of the pen and strike the rail or fender, and if a little pig is there he has some chance of not being squeezed to death, because the fender keeps the sow's weight off him.—*K. W. Gorringe.*

TAKE-ALL DISEASE IN WHEAT.

ETIOLOGY OF *OPHIOBOLUS GRAMINIS* SACC.

R. WATERS, Biological Laboratory.

SEEING that there is considerable uncertainty in the minds of plant-pathologists as to the cause of the condition known as "take-all" in wheat the following notes upon the pathogenicity of *Ophiobolus graminis* may be of interest:—

In January, 1920, specimens of wheat bearing perithecia of *O. graminis* were collected from various parts of the Canterbury Province. A few of these perithecia were induced to put forth tendrils (see March, 1920, issue of this *Journal*, p. 141), and ascospores therefrom were plated out. The mycelium developing upon beef-peptone-agar is white and shows only slight aerial growth, the hyphae, especially at the edge of the colony, spreading outward through the medium or closely adhering to its surface. When hyphae growing outward at the edge of a colony meet they thereafter frequently continue to develop parallel and adjacent to one another. Thus, under a low power the peripheral hyphae were seen running adjacent to one another, often in bundles of a dozen or more. No fructifications were produced.

On 21st February White Straw Tuscan wheat was sown in a pot, and small pieces of medium containing *Ophiobolus* mycelium were placed upon culms (previously sterilized), which were quickly enclosed in a glass tube plugged each end with cotton-wool. After fifty-four days the plants so treated had not shown signs of disease.

On 15th March, various other unsatisfactory inoculation methods having been tried, six sterilized and aseptically germinated White Straw Tuscan seeds were placed each in a separate tube containing sterile moistened potting-soil. To each of the tubes numbered 1 to 4 a small piece of medium containing mycelium of *Ophiobolus graminis* was added, both seeds and mycelium being placed upon the surface of the sterile soil. To tubes 5 and 6—the controls—no inoculum was added. The plant in tube 1 was dead on 12th April—*i.e.*, twenty-eight days; that in tube 2 was dead on 18th April, thirty-four days; and those in tubes 3 and 4 were dead on 20th April, or thirty-six days. The controls still showed no signs of failing on 12th May—*i.e.*, twenty-two days after the last inoculated plant had died. No fructifications have yet formed upon the plants that have been killed. On 2nd May four pieces of dead wheat rootlet from tube 2 were placed upon a beef-peptone-agar plate. Four days later from all four there had developed an abundant mycelium typical of that originally secured from the plating out of the ascospores of *O. graminis*.

COMMENTS.

1. The failure of the mycelium to produce infection when applied direct to the culms suggests that the fungus causes infection below or at ground-level. If this is so it could certainly spread from plant to plant by means of the roots, and may even be capable of spreading through the soil.

2. The results to date of the experiments in tubes 1 to 6 indicate that *Ophiobolus graminis* is a parasite of wheat, and is at least one of the causes of the "take-all" condition. More extensive experiments are, however, now in hand.

3. An interesting point in regard to these experiments is the rapidity with which death occurred. Delacroix* secured only traces of disease after three or four months. He, however, used ascospores suspended in water, while in the writer's experiments pieces of pure vigorous cultures of mycelium derived from ascospores were placed upon the soil in which the wheat-plants were grown.

4. It may be remarked that in all cases those plants that were nearest to the added inoculum died first.

* Delacroix, 1901, "Sur le piétin des céréales," Bull. Soc. Myc. de France, 17.

Limestones.—Samples of limestone recently analysed by the Chemistry Section gave the following percentages of carbonate of lime: Gladstone, 81 to 92·5; Port Albert, 72 and 80·5; Balfour, 83; Paparoa, 91; Kaukapakapa, 80; Oamaru, 92.

Ensilage at Weraroa.—Six acres of maize at the Central Development Farm, intended for feeding-out but not required, has been stack-ensilaged, with the addition of threshed pea-straw, the object being to make a better-balanced food ration.

Pasture in the Mackenzie Country.—A pasture and fodder-plant experimental area established by the Department before the war, at Whalesback, in the Mackenzie country, Canterbury, was recently examined, after lying without attention since 1914. Tall oat-grass has done well, and is seeding and spreading over the area. Cocksfoot comes next. Bent-grasses, fescues, red clover, and alsike are also showing up, while white wild clover is covering considerable areas with a strong vigorous mat. Of the deep-rooted plants, sheep's burnet has done well, and yarrow and chicory occupy a prominent place in the several sowings made. A variety test of lucerne was also sown on this area. The Peruvian and Hungarian varieties are the only survivors. This is a case of the survival of the fittest under climatic conditions of great extremes. It has to be remembered that no inoculated soil was applied to the plots seeded to lucerne. The area was securely fenced in, and no stock has been admitted during the period covered. —*A. Macpherson, Fields Supervisor.*

CALF-REARING.

FEEDING EXPERIMENTS AT RUAKURA AND WERAROA.

J. L. BRUCE, Superintendent of Experimental Farms.

THE present development of the dairy industry in New Zealand on lines which absorb the whole of the milk or involve the extraction of practically all feeding-matter therefrom is bringing about a position which threatens both dairying itself and beef-production. The rearing of calves is now one of the main problems confronting our dairy-farmers. Increasingly deprived of skim-milk and even ordinary whey, it has become more and more necessary to turn to other foods. The present high prices of such feeding-stuffs, if all purchased outside, may make rearing with their aid comparatively expensive; but a great many more dairy-farmers could and should grow the necessary crops, such as oats, linseed, and beans, for use on the farm. The dairyman must consider his future herd, and as a rule it will be sound economy for him to save and rear well at least his best heifer calves. The ordinary run of calves could also be profitably reared by the system of feeding here dealt with, but in their case the rearing seems likely to develop in the near future into a special and separate business on large-scale lines.

With the object of obtaining reliable local data as to what extent supplementary foods (mainly home-grown) can be profitably substituted for milk and whey, a scheme of feeding-tests, combined with the best practice in calf-rearing generally, was undertaken at the Department's experimental farms during the past season. In each case sixteen calves, most of which would otherwise have been slaughtered for their skins, were purchased soon after birth, divided into four groups of four each and fed strictly on the respective dietary assigned to each group, the period of the test being seventeen weeks. The results of the tests, as recorded in the matter which follows, are instructive, and go to show that the produce of the dairy can be very largely eliminated from the dietary of calves. There have been no deaths, and at the time of writing the calves are in excellent health and compare well with others reared mainly on milk.

Referring to the cost debited to each food in the several groups, these items may be regarded as average values current at the period of the tests, and are, of course, subject to variation according to circumstances. Farmers can readily work out costs in their own case on a similar basis.

In regard to general rearing practice, the writer is more than ever convinced that the *ancient calf-paddock* has been responsible for more ailments in cattle than possibly any other cause. It is essential tha it be abolished and replaced by clean new grass pasture, preferably limed when sown down—no matter what the dietary of the calve may be.

RUAKURA GROUP 1.

Whole milk, 8 lb. per day for two weeks; whole linseed 8 oz., flour 2 oz., plus skim-milk 15 lb., per day for fifteen weeks. Average daily gain per calf, 1·61 lb.

RUAKURA GROUP 2.

Whole milk, 8 lb. per day for two weeks; linseed-meal 7½ oz., bean-meal 12 oz., plus skim-milk 8 lb., per day for two weeks, after which skim-milk discontinued and water substituted for thirteen weeks. Average daily gain per calf, 1·36 lb.

RUAKURA GROUP 3.

Whole milk, 8 lb. per day for two weeks; oatmeal 8 oz., crushed linseed 4 oz., plus skim-milk 15 lb., per day for fifteen weeks. Average daily gain per calf, 1·54 lb.

RUAKURA GROUP 4.

Whole milk, 8 lb. per day for two weeks; crushed linseed 9 oz., plus skim-milk 15 lb., per day for fifteen weeks. Average daily gain per calf, 1·77 lb.

THE RUAKURA TESTS.

The following are particulars of the tests conducted at the Ruakura Farm of Instruction, Hamilton:—

The calves comprised sixteen non-pedigree heifers under one week old, purchased in the public saleyards at a cost of a few shillings each. These represented the ordinary-grade stock that came into the market. The calves consisted of twelve Shorthorns and four Shorthorn-Jersey crossbreds.

All calves were weighed on the same day, and then divided into four groups according to weights. The variation in the total weights for the four groups was only 2 lb., so that all lots commenced practically at the same mark. In making up the groups one Shorthorn-Jersey crossbred was placed in each group, this being the lightest calf in each group.

A shed was provided for shelter at nights for the first month. The animals were fed three times daily in separate bails. They had a clean run on to fresh pasture, a field of Western Wolths rye-grass and red clover sown the previous autumn being set aside for this purpose. Clean drinking-water and a salt lick were within reach of the calves. All ran together in the same field during the day, and were housed in the same shed at night.

The calves when purchased were given one tablespoonful of castor-oil, and all fed on new milk for the first two weeks. At the end of the fortnight the four lots were placed on the dietaries set forth in the following statements, which also give details of gains, &c., for each group:—

Group 1.

Feeding formula: Whole milk, 8 lb. per day for two weeks; whole linseed 8 oz., flour 2 oz., plus skim-milk 15 lb., per day for fifteen weeks.

Preparation: Whole linseed soaked overnight in water and boiled for twenty minutes next day; flour mixed with a little water and added five minutes before boiling completed.

Weights and gains: Four calves—91 lb., 74 lb., 73 lb., and 63 lb.: total first weight, 301 lb.; total final weight (seventeen weeks), 1,071 lb.; total gain, 770 lb.; average daily gain of each calf, 1·61 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 1s. 7d. per pound, 6s. 8d.; whole linseed, 52½ lb. at 3d. per pound, 13s. 1½d.; flour, 13⅛ lb. at 15s. per 100 lb., 2s.; skim-milk, 157½ gallons at 1d. per gallon, 13s. 1½d.: total cost of food per head for period of test, £1 14s. 11d.

Group 2.

Feeding formula: Whole milk, 8 lb. per day for two weeks; linseed-meal 7½ oz., bean-meal 12 oz., plus skim-milk 8 lb., per day for two weeks, after which the skim-milk was discontinued and water substituted during the remainder of the test (thirteen weeks).

Preparation: Boiling water, 30 quarts, added to 3 quarts of linseed-meal and 4 quarts of bean-meal, the whole covered up for twenty-four hours.

Weights and gains: Four calves—90 lb., 74 lb., 73 lb., and 65 lb.: total first weight, 302 lb.; total final weight, 952 lb.; total gain, 650 lb.; average daily gain of each calf, 1·36 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 1s. 7d. per pound, 6s. 8d.; linseed-meal, 49$\frac{7}{32}$ lb. at 3d. per pound, 12s. 3½d.; bean-meal, 72½ lb. at 1d. per pound, 6s. 0½d.; skim-milk, 11 gallons at 1d. per gallon, 11d.: total cost of food per head for period of test, £1 8s. 11d.

Group 3.

Feeding formula: Whole milk, 8 lb. per day for two weeks; oatmeal 8 oz., crushed linseed 4 oz., plus skim-milk 15 lb., per day for fifteen weeks.

Preparation: Oatmeal 2 parts, crushed linseed 1 part, made into a porridge and mixed hot with skim-milk.

Weights and gains: Four calves—88 lb., 79 lb., 69 lb., and 67 lb.: total first weight, 303 lb.; total final weight, 1,036 lb.; total gain, 733 lb.; average daily gain of each calf, 1·54 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 1s. 7d. per pound, 6s. 8d.; oatmeal, 52½ lb. at 3d. per pound, 13s. 1½d.; crushed linseed, 26¼ lb. at 3d. per pound, 6s. 7d.; skim-milk, 158 gallons at 1d. per gallon, 13s. 2d.: total cost of food per head for period of test, £1 19s. 6½d.

Group 4.

Feeding formula: Whole milk, 8 lb. per day for two weeks; crushed linseed 9 oz., plus skim-milk 15 lb., per day for fifteen weeks.

Preparation: Dry crushed linseed stirred into the skim-milk immediately before feeding.

Weights and gains: Four calves—81 lb., 81 lb., 72 lb., and 67 lb.: total first weight, 301 lb.; total final weight, 1,148 lb.; total gain, 847 lb.; average daily gain of each calf, 1·77 lb.

Quantities and cost of feed per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 1s. 7d. per pound, 6s. 8d.; crushed linseed, 59$\frac{1}{16}$ lb. at 3d. per pound, 14s. 9d.; skim-milk, 158 gallons at 1d. per gallon, 13s. 2d.: total cost of food per head for period of test, £1 14s. 7d.

Notes on Results.

From the foregoing it will be seen that the dry crushed linseed added to skim-milk gave the highest daily increase in weight. This ration requires no preparation, and consequently entails the least labour. The calves carried good condition throughout, but did not have the fine glossy skins that were seen in group 3. There is not the least doubt that the oatmeal and crushed-linseed porridge gave the calves a better appearance, and this can be noticed in the accompanying photographs of the various groups.

When changing calves from milk to bean and linseed meals and water a considerable amount of difficulty was experienced in getting the calves to take the latter preparation, and for a few days a little skim-milk had to be added to make the change more gradual. Throughout the experiment the calves did not take this ration readily. It was

WERAROA GROUP 1.

Whole milk, 8 lb. per day for two weeks; skim-milk, 16 lb. per day for two weeks; flour 4 oz., and linseed-meal 3 oz., per day for thirteen weeks. Average daily gain per calf, 1·5 lb.

WERAROA GROUP 2.

Whole milk, 8 lb. per day for two weeks; skim-milk, 16 lb. per day for two weeks; crushed oats, 1 lb. per day for thirteen weeks. Average daily gain per calf, 1·7 lb.

WERAROA GROUP 3.

Whole milk, 8 lb. per day for two weeks; skim-milk 16 lb., plus 1 quart linseed-gruel, per day for fifteen weeks. Average daily gain per calf, 1·6 lb.

WERAROA GROUP 4.

Whole milk, 8½ lb. per day for one week; skim-milk, 16 lb. per day for one week; bean-meal 8 oz., linseed-meal 6 oz., cooked and fed with 3 quarts warm water, per day for fifteen weeks. Average daily gain per calf, 2·3 lb.

found that this food when prepared would not keep sweet like the other foods, and after twenty-four hours had a sour smell. On this season's experience bean-meal has proved unsatisfactory.

It is desirable to stress upon all those who wish to rear calves successfully, and at the lowest cost, the importance of clean fields and pastures, clean drinking-water, cleanliness in and around the feeding-yards and bails, and regular and proper methods of feeding. It is useless to attempt to rear calves if these important facts are ignored. The success of the trials at Ruakura was determined to a large extent by the ideal conditions under which the calves were kept. It was observed that calves of superior breeding and receiving better feeding, but kept on old pasture and in close proximity to cow sheds and yards, did not thrive to the same extent as those included in this experiment.

THE WERAROA TESTS.

Particulars of the tests conducted at the Central Development Farm, Weraroa, are as follows:—

Group 1.

Feeding formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 16 lb. per day for two weeks; flour 4 oz., and linseed-meal 3 oz., per day for thirteen weeks.

Preparation: Linseed soaked overnight in 2¼ pints water, boiled next day for twenty minutes, adding flour (which has been previously mixed to a smooth paste with cold water) five minutes before boiling completed.

Weights and gains: Four calves—68 lb., 70 lb., 62 lb., and 61 lb.: total first weight, 261 lb.; total final weight (seventeen weeks), 979 lb.; total gain, 718 lb.; average daily gain of each calf, 1·5 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 1s. 7d. per pound, 6s. 8d.; skim-milk, 23½ gallons at 1d. per gallon, 1s. 11½d.; flour, 26 lb. at 15s. per 100 lb., 3s. 11d.; linseed, 19 lb. at 3d. per pound, 4s. 9d.: total cost of food per head for period of test, 17s. 3½d.

Group 2.

Feeding formula: Whole milk, 8 lb. per day for two weeks; skim-milk, 16 lb. per day for two weeks; crushed oats, 1 lb. per day for thirteen weeks.

Preparation: Crushed oats fed dry.

Weights and gains: Four calves—79 lb., 77 lb., 64 lb., and 60 lb.: total first weight, 280 lb.; total final weight, 1,102 lb.; total gain, 822 lb.; average daily gain of each calf, 1·7 lb.

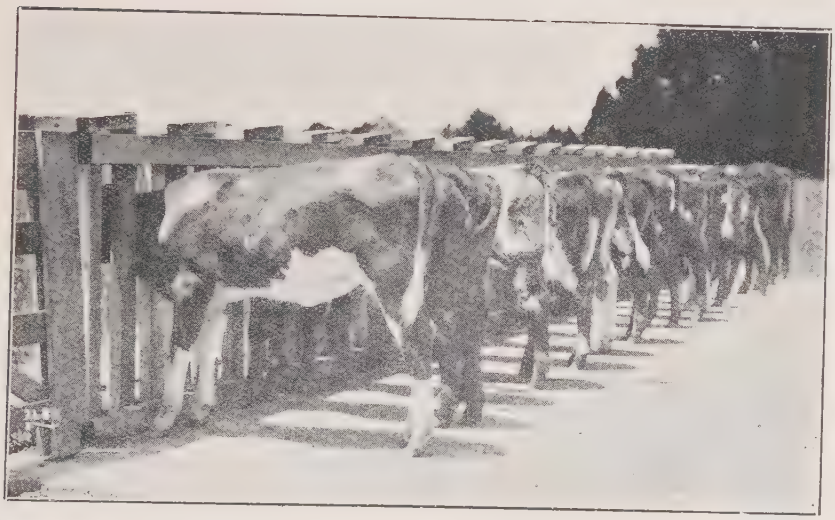
Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 1s. 7d. per pound, 6s. 8d.; skim-milk, 23½ gallons at 1d. per gallon, 1s. 11½d.; crushed oats, 91 lb. at 4s. 6d. per bushel, 11s. 3d.; total cost of food per head for period of test, 19s. 10½d.

Group 3.

Feeding formula: Whole milk, 8 lb. per day for two weeks; skim-milk 16 lb., plus 1 quart of linseed-gruel, per day for fifteen weeks.

Preparation: ¼ lb. linseed in 1 quart of water, boiled to a jelly.

THE TEST CALVES AT RUAKURA BAILED UP FOR FEEDING.



REAR VIEW OF SAME, SHOWING CONCRETE YARD.

Weights and gains: Four calves—68 lb., 70 lb., 60 lb., and 64 lb.: total first weight, 262 lb.; total final weight, 1,032 lb.; total gain, 770 lb.; average daily gain of each calf, 1·6 lb.

Quantities and cost of food per head: Whole milk, 112 lb. = 4·2 lb. butterfat at 1s. 7d. per pound, 6s. 8d.; skim-milk, 168 gallons at 1d. per gallon, 14s.; linseed-meal, 26¼ lb. at 3d. per pound, 6s. 7d.: total cost of food per head for period of test, £1 7s. 3d.

Group 4.

Feeding formula: Whole milk, 8½ lb. per day for one week; skim-milk, 16 lb. per day for one week; bean-meal 8 oz., linseed-meal 6 oz., well cooked and fed with 3 quarts of warm water, per day for fifteen weeks.

Preparation: Boiling water 30 quarts, added to 3 quarts of linseed meal, plus 4 quarts of bean-meal, the whole mixed and covered for twenty-four hours.

Weights and gains: Four calves—71 lb., 75 lb., 70 lb., and 62 lb.: total first weight, 278 lb.; total final weight, 1,355 lb.; total gain, 1,077 lb.; average daily gain of each calf, 2·3 lb.

Quantities and cost of food per head: Whole milk, 60 lb. = 2·25 lb. butterfat at 1s. 7d. per pound, 3s. 7d.; skim-milk, 12 gallons at 1d. per gallon, 1s.; bean-meal, 52½ lb. at 1d. per pound, 4s. 4½d.; linseed-meal, 39½ lb. at 3d. per pound, 9s. 10½d.: total cost of food per head for period of test, 18s. 10d.

Notes.

The calves used for the Weraroa tests were crossbreds, comprising Friesian-Jersey, Shorthorn-Jersey, Ayrshire-Jersey, Friesian-Shorthorn, and Guernsey-Jersey, also grade Jersey.

The substitution of the various foods which finally replaced the milk ration was brought about gradually. Thus, before the end of the new-milk period a little skim-milk was introduced, and increased until the ration was all skim. Other food changes were made similarly, and the animals at no time suffered any check.

It was clearly demonstrated throughout the tests that the most important and essential factors in calf-rearing (apart from the dietary) were (1) a clean new grass-paddock, (2) a good supply of fresh drinking-water, and (3) clean feeding-utensils. There is no doubt that the absence of scour among the calves was largely due to the latter precaution.

Sore Hands after Concrete-work.—A Dannevirke correspondent writes: "When working with concrete, cement, or lime one's hands are apt to get dry and sore. For some years past I have found the following treatment to give sure relief. As soon as possible after work is finished get a basin of warm water, and with soap work up a good lather on the hands. Then take a teaspoonful of sugar among the lather, and work it into the hands and finger-nails for a minute before rinsing. The hands will then be quite clean and all soreness gone.

WEEDS AND THEIR IDENTIFICATION.

(Continued.)

E. H. ATKINSON, Biological Laboratory.

LANTANA (*LANTANA CAMARA* L.).

By Order in Council gazetted on 27th November, 1919, the subject of this article was added to the Third Schedule of the Noxious Weeds Act—*i.e.*, it is a noxious weed when so declared by the local authority. The accompanying description and illustration are presented with the object of making the plant more readily recognizable by farmers and others who may happen to come across it.

DESCRIPTION.

Lantana Camara is a tall rambling shrub reaching an extreme height of 10 ft. or so. The branches, which are brittle, are decidedly four-angled, and are usually armed with numerous short, strong, recurved prickles, borne only at the angles of the stems. As a rule—though this is a variable character—the whole surface of the branchlets is covered with short stiff hairs, which are particularly abundant towards the young tips.

The leaves, too, are hairy, especially in the case of the under-surfaces of the newly developed ones, where the hairy covering is often so thick as almost to form a felt. In outline they are ovate (egg-shaped) or even slightly heart-shaped at the base, with a somewhat gradually tapering tip. The edge of the leaf is cut into numerous rather blunt teeth, which are less conspicuous at its base. The leaves spring in opposite pairs from the stems, each pair being set at right angles to those above and below it.

The flowers are borne in small heads not unlike those of the garden verbenas only less than half the size, the heads themselves being carried on stalks which arise from the axils of the upper leaves. These stalks are at first short, but elongate considerably as flowering progresses, so that the younger flower-heads are often overtopped by the older ones. The individual flowers, which grow out from between short and narrow hairy bracts, are small—from $\frac{1}{4}$ in. to $\frac{1}{3}$ in. in length—tubular in shape, spreading above into four rather irregular lobes, and in colour pink, or in some forms yellow or orange, turning later to red.

The fruit is berry-like, about $\frac{1}{6}$ in. in diameter, dark-coloured, and very juicy when fresh.

All parts of the plant, particularly the leaves, have a strong and rather pleasant scent.

DISTRIBUTION.

Lantana belongs to a family which comprises several plants well known both in gardens and in the wild state in New Zealand, among the former being the gaily-coloured verbenas, while among the wild plants the puriri, in the North, is one of the best known and most valuable of native trees. The genus *Lantana* has its headquarters in tropical and subtropical America, and it is from thence that

LANTANA CAMARA.

Flowering and fruiting branch, about half natural size.

[*Drawing by E. H. Atkinson.*

L. Camara (the species under consideration) has spread widely in various warm countries, including Ceylon, many of the Pacific islands, and the northern parts of Australia and New Zealand.

In this Dominion, as far as is known, lantana is at present practically confined to the country adjoining the Hokianga River and Harbour, where it was first recorded twenty-five years ago. It is particularly abundant at Kohukohu, on the northern waterfront of the harbour. Mr. J. W. Otway, Stock Inspector, Ohaeawai (whose assistance in supplying material has been invaluable), reports as follows: "As regards the spreading of lantana, although there are some acres of it in and around Kohukohu it does not seem to be spreading very fast, as it seems to prefer the covered country. I found plenty of seedlings in the bush reserve at Kohukohu, but out on the open grass-country, except for a few scattered bushes, I did not find any. The bushes, although large, do not seem to be thriving. I did not see any evidence that either frost or stock touch it in any way." Lantana has also been reported from the Northern Wairoa, but information as to this habitat is somewhat vague.

Though lantana occupies immense areas in some of the countries previously mentioned, the present economic position of the plant in the Dominion is one of minor importance only, its inclusion in the Noxious Weeds Act having been thought advisable chiefly on the evidence of its aggressiveness elsewhere under conditions not altogether dissimilar to those obtaining in the north of New Zealand.

In Queensland and New South Wales it has overrun many of the river scrubs and become a well-known pest, though it is considered to be not without redeeming qualities, owing to its fallowing properties and because the leaves form a mulch for the ground. As regards the injuriousness of the plant to stock, Mr. J. H. Maiden, F.R.S., Government Botanist of New South Wales, writes: "We have two forms of the species, the common pink-flowered form and a form with orange-coloured flowers, chiefly found on the northern rivers, and also in Queensland. It is the second kind which is accused of causing "pink-nose" in cattle in northern Queensland. I have not heard of the common lantana being noxious to stock in New South Wales, though occasionally in a droughty season one hears words to that effect, but without any details that one can follow up." The pink-flowered form seems to be the one found in New Zealand, and as no reports have been received of stock eating it here no trouble need be anticipated in this direction.

It should be mentioned that F. M. Bailey, in "Weeds and Suspected Poisonous Plants of Queensland," states that children have frequently been made ill from eating the fruit.

The position in regard to lantana in New Zealand may be summed up as follows: The plant has been naturalized for at least a quarter of a century in North Auckland and during that time has spread quite slowly. Were it not for the plant's bad reputation elsewhere it is therefore probable that but little attention would have been called to it. At the same time it would be unwise to disregard altogether the possibilities of the plant as a weed, and the Department would be grateful for any fresh information as to its occurrence in habitats other than those here mentioned, and also as to its behaviour under various conditions of environment.

MILK AND CREAM FOR FACTORY SUPPLY.

(Concluded.)

G. M. VALENTINE, Dairy Instructor, Auckland.

WASHING-UP OPERATIONS.

WASHING-UP is a simple matter if gone about in the right way, which is to do it as soon as milking is finished. If proper conveniences are provided it takes less time to do the work well than to half do it, because in such case the utensils are never allowed to get really dirty. A good set of brushes, an ample supply of hot water, and one or two tubs are required. Rags for washing dairy utensils are quite useless. They do not get into the corners, and are frequently allowed to get so foul as to be a hotbed for the propagation of germs. First rinse with cold water everything with which the milk comes in contact. Then scrub thoroughly in warm water in which some soda or other cleanser has been dissolved. Lastly, scald in boiling water.

Tinware treated in this manner will look bright and new after years of use, as the heat of the boiling water will dry it off at once and prevent the formation of rust. Contrast this with utensils washed in cold water only. The tinware has a dull, black appearance, and if rubbed with the fingers a greasy smudge appears. A yellow deposit of stale milk will usually be found in the seams, and rust soon makes its appearance. Milk or cream from such a dairy cannot be expected to reach the factory in good order, as they are contaminated before they leave the farm.

It is not necessary to scour dairy utensils with Bath brick, sand-soap, or metal-polish. It is, indeed, a great mistake to do so, as it removes the coating of tin from the steel of which the so-called tinware is made, and causes it to rust. If it is desired to give tinware an extra good scouring, dip a damp brush in some cleansing-powder which is not of a gritty nature.

Where whey is taken home in the cans it should be emptied at once on arrival, and special attention given to the washing.

THE SEPARATOR.

Leaving the separator overnight without washing is a dirty practice, and is altogether too common. By "washing" is meant taking to pieces and washing in the proper way, not merely running some water through when separating is finished. In the latter case the deposit of slime and dirt which remains in the bowl even in the cleanest dairy is left steeping in water all night, with the result that a plentiful crop of germs is developed to contaminate the milk which goes through the separator next morning. The supplier who would not dream of using a bucket which was as dirty as the separator-bowl will not hesitate to use the separator without washing it.

There is no saving of time by leaving the separator unwashed overnight, as, owing to the milk being dried on, it will take longer to wash

it next morming. This practice is also a direct loss to the supplier. The separator is designed to exert a certain amount of centrifugal force on the milk, and the diameter and speed of the bowl are worked out on lines which ensure the best results in skimming. As the amount of dirt in the bowl increases the diameter decreases, and the loss of fat in the skim-milk increases accordingly. This could be carried on to the point where the milk is not separated at all and the whole bowl is choked. Obviously, if the bowl starts in the morning with an accumulation of dirt the loss in skimming must be greater than if starting with a clean bowl. Then the supplier will find that no matter how he alters his cream-screw he cannot get his test up. Needless to say, cream from a separator treated in this way is poor in flavour.

The washing of the separator is not complete until the frame has been wiped over with a damp cloth, benches washed down, and the floor of the separator-room thoroughly scrubbed. If possible, place the tinware where the sun shines directly on to it.

THE MILKING-MACHINE.

The easiest way to keep a milking-machine clean is to prevent it ever getting dirty. This is comparatively easy if it is properly washed from the first time of using. The secret lies in doing so as soon as milking is finished, before the milk dries on. If the machine is allowed to get really dirty washing is a very difficult matter indeed.

The casein in milk is one of the strongest adhesives known, which is the reason of its value for making paints, glues, &c. It is therefore very difficult to remove the casein once it has got into milk-pipes. No milking-machine can be washed in a few minutes, as sometimes stated by energetic salesmen. The story that the releaser need only be taken down every three months, that the vacuum-tank does not require attention, and that the air-system has nothing to do with the milk, has been exploded long since. A regular system of cleaning should be laid down and followed, and very little trouble will then be experienced in supplying milk and cream of good quality.

Immediately milking is finished draw some cold water through all the milk-pipes. Remove teat-cups and milk-tubes, then draw some hot-water cleanser through the down-drops into the releaser. Run a wire brush through the down-drops, rubber connections, and taps. Brush the overhead milk-pipe by passing through it a brush attached to a line. The vacuum will carry the brush into the pipe, and it can be drawn back and forth with the line. Then take some boiling water and draw it through the pipes until they are heated right through to the releaser. Place teat-cups and milk-tubes in a tub, and pass the brush through all the parts with which the milk comes into contact. Wash the dirt from the outside, rinse in clean water, and scald in boiling water.

The scalding is the most important part of the washing-up, and if done properly there will be little trouble with milking-machine flavour. The object of scalding is to kill the germs, and make the pipes so hot that they will dry off and leave no damp spots in which germs can develop before next milking. It is not uncommon to find that pipes which have been left damp have been fly-blown between milkings. If only hot water is available it cools before it gets half-way through the

machine, and is consequently of little value. Some machine-users make the objection that the boiling water cracks the sight-glasses; but these can be replaced with celluloid. Others say that it spoils the rubbers. The worst enemy of rubber is grease, and the hotter the water the less likelihood is there of grease getting into the rubber.

It is necessary to take down and wash the releaser every day, a simple matter with present-day releasers. The lid of the vacuum-tank should be removed daily, and the tank scrubbed out at least once a week. Take to pieces the whole of the inflation, claws, milk-tubes, down-drops, and overhead milk-pipes twice weekly, and scrub them with the brushes supplied for the purpose. Boil all milk-tubes, except the inflations, for fifteen minutes once weekly in water to which some soda has been added. This will get rid of the grease and preserve the rubbers. In some cases the latter have been in use for five years with this treatment. If boiled in a kerosene-tin place the rubbers in a sugar-bag, so as to keep them off the bottom of the tin, where they would come in contact with the flames.

Any dullness in the metal pipes of a milking-machine is an indication that they are dirty. It is a common experience to come across machines in which the overhead pipe is as bright as a new gun-barrel, while the down-drops are very dirty. This is because of the regular practice of putting the brush through the large pipe only. The rubber connection between the down-drop and the overhead pipe is another frequent cause of trouble. Judging by the difficulty in getting it off, it is never removed in some sheds.

After scalding, place the teat-cups and tubes in a tub of clean water to which some cleanser, salt, limewater (not dry lime), permanganate of potash (very weak), or similar preparation has been added. This water must be renewed daily, or it will do more harm than good. It can be used to wash down the floor of the shed each morning. Nothing could be worse than the filthy mixture resulting from the practice of putting dirty teat-cups (which have fallen on to the floor during milking) into a tub of fluid several days old. In such case the cups are taken out with more or less of the liquid adhering to the inside of the inflations and milk-tubes, and when the machine is started it is drawn into the milk. With machines having only one pipe for both air and milk any of this liquid which has got in between the inflation and the teat-cup will also be drawn into the milk through the air-tubes.

Where separate air and milk systems are provided, the air-pipes frequently become foul. Cases have occurred where the automatic pulsator has refused duty as the result of an accumulation of dirt in these pipes. A broken inflation will have the same result, and when this happens the pipes should be at once flushed out in the same way as the milk-pipes. In ordinary practice this should be done every week, and will keep the pipes clean up to the vacuum-tank.

The pipe from the releaser to the vacuum-tank and thence to the pump is a source of infection in a great many dairies. It is very seldom washed, and soon gets dirty with the condensation of the milk-vapour. It is a hard matter to convince many dairy-farmers that this pipe has any influence on the quality of the milk, as the suction is all towards the pump. The number of cases in which taints have disappeared after this pipe was attended to, however, leaves no room for argument

on this point. If unions and rubber joints are provided it is an easy matter to take the pipe down and wash it out. When the air-pipes have got into a very dirty state the only way to thoroughly clean them is by burning them in a fire, when hammering on the outside will remove the scale. If drawn-brass pipes are erected in the first instance very little trouble will be experienced in keeping them clean, and if they should happen to get dirty it is an easy matter to wash them out with a brush and hot water. The vacuum-pump must also receive its share of attention, as it gets just as dirty as the air-pipes. Finally, dairymen should remember that for cleaning a milking-machine no cleanser has yet been discovered which will take the place of hard work and boiling water.

THE MILKING-SHED.

Cleanliness in the shed is a matter in many cases which does not receive the attention it deserves. Like all other things in the dairy, it is an easy matter to keep a shed clean if the work is done regularly. With an ample water-supply and a concrete floor it is only a matter of minutes to wash the whole place out. A wooden floor is difficult to keep clean. With clay or metal it is almost impossible to keep the floor as it should be, though a sprinkling of slaked lime after cleaning will help to keep down any offensive smell.

The manure-heap should not be any closer than 30 ft. from the opposite end of the shed to the separator-room. All doors should be left open between milkings, so as to give free play to the wind and allow as much sun into the shed as possible. A coating of limewash once a year will improve the appearance of the shed and assist in keeping down disease in the herd.

GENERAL.

The objection may be made that if everything here detailed is carried out it will be one person's work to look after the machines and dairy. If left to one person, that is quite true, but it is the only way in which quality, which is the foundation of the whole dairy business, can be maintained. The same may be said of the work of washing up in a factory, but no one would suggest that it should be neglected because it takes a lot of time. Thousands of dairymen are working every day on the lines indicated, and they are the men who are holding up the reputation of our butter and cheese. Generally speaking, these are the men who are afraid that they are not doing as much as they should and are always on the lookout for hints as how to do better.

CREAM-GRADING.

It is estimated that about 10 per cent. of the milk and cream received at our factories is choice, 80 per cent. fair, and the balance poor. With the exercise of a little more care the great bulk of that 80 per cent. could be raised to choice quality. In a great many cases the reason why that extra care is not taken is that no more will be received as a result. Virtue as its own reward does not appeal to the average dairyman.

Cream-grading has been carried out in several districts in the Dominion for the past few years, but grading of milk has not been

attempted. There seems to be no reason why milk should not be graded as well as cream. The defects may not be so apparent in fresh milk as in cream which is two days old, but cheesemakers will hardly admit that they are poorer judges of quality than buttermakers. They usually know whose milk to use when making show cheese, and have the advantage of the curd-test to verify their judgment.

There is nothing mysterious or impossible in the production of first-class milk and cream, though circumstances may make it more difficult in some cases than in others. All that is required is strict cleanliness and proper cooling; the bulk of the bad cream received is the result of neglect of these two points. The quantity which is defective from other causes is very small indeed, and a little investigation on the spot will usually locate these causes.*

Among objections made to the grading of cream is the argument that the supplier who lives at a distance from the factory is placed at a disadvantage. Experience has shown that this is not the case, as suppliers so situated frequently send in the best cream received. This is no doubt due to the fact that owing to their position extra care is taken, while the nearby supplier thinks that, being so close, no care is necessary. The fact is that good cream takes a lot of spoiling, but bad cream is spoilt before it leaves the farm. Another objection is that cream that is good when it leaves the farm may be spoilt as the result of the treatment it receives on the road. This is not likely, and only shows that such defects in transit have been noticed by the supplier, but he has not been sufficiently interested to get busy and have them remedied.

Then there is the threadbare excuse of feed flavours, usually advanced by the man who has never used a cooler and stirrer. Generally speaking, feed flavour is looked upon as a defect which cannot be helped, and that therefore it should not be graded down. Cream is graded down not because of the flavour which it contains but because of the flavour it imparts to the butter made from it. Whether the flavour is preventable or not does not enter into the question, as that point is not considered by the butter-buyer. Even feed flavour may be largely controlled. Turnip flavour seems to be largely a matter of care in feeding; if the roots are pulled a day or two before feeding and the feeding not overdone no great harm seems to result, provided proper attention is paid to the care of the cream. The onus of supplying a good cream while feeding turnips is on the supplier, and though they may be the cause of a bad flavour that cannot be accepted as an excuse for it. Again, with *Lotus major* pasture, flavour may be overcome by consistent cooling. The writer met with a case of trouble from this cause in which the night's cream was first grade and the morning's cream second grade. Inquiries showed that the

* In possibly 1 per cent. of cases no reason can be found for a defect even on the closest investigation. In such a case pasteurizing the cream on the farm will usually prove successful; but this is really a last resource, and not to be recommended except in extreme cases. Great care must be taken, or more harm than good will be done. Place the can containing the cream in a copper of water, and bring the temperature of the cream up to about 150° F. Hold it at that temperature for about ten minutes, then cool as rapidly as possible. If there is only a small quantity it may be mixed and treated once daily, but in no case must the cream be placed directly on the fire.

morning's cream had not been cooled, hence the strong feed flavour and consequent second grade. This was clearly a case where feed flavour was the cause, but no excuse for the second grade. Grading combined with instruction on the farm is now being carried ou tat a number of factories with very satisfactory results.

Until the year before last the cream was graded into two classes only—first and second grade—the difference in the corresponding price ranging from ½d. to 2d. per pound in various districts. Experience has shown that where ½d. only was deducted the difference in price was not sufficient to induce the careless supplier to improve.

GRADING ON POINTS.

During the last two years a step forward has been made by the adoption of the system of grading on points. The results have been so satisfactory that quite a number of factories are paying for cream on this system this season. Many others have adopted a modification of the same system by making a choice grade, for which ½d. extra is paid but no pointing is done. In the complete system the points are the same as those allotted in butter-grading—that is, under 88 points is second grade, 88 to 91 first grade, and 92 and over is choice. For this choice quality ½d. per pound more than for first grade is paid, while ½d. per pound less than for first grade is paid for second grade. For example, if 1s. 4d. is being paid for first grade 1s. 3½d. will be paid for second and 1s. 4½d. for choice quality. While the supplier of second-grade cream is not paid any less than before, the one sending in first grade has some reward, and the supplier who sends in choice quality is further paid for the extra care taken. The points, however, are not detailed under separate heads as in butter-grading, and there are no half-points.

The improvement in the quality of the cream supplied to those factories which have adopted this system has been very marked, and the quality of the butter made has improved correspondingly. Careful experiments have been made to test the system, and when the cream has been churned in the qualities as graded at the factories the results at the grading-stores have corresponded, except that second-grade cream has sometimes made third-grade butter. This system must appeal to any one having a knowledge of the business as being on right lines. Without pointing, the success which has followed the grading of butter and cheese could not have been fully attained. A grade-note which simply stated that the line of produce to which it referred had been classed first, second, or third grade would appeal to very few managers. Without such a system the 80 per cent. of suppliers who send in the bulk of our cream have no means of knowing whether they are just getting into first grade or just missing the choice score, and there is no particular inducement for them to find out. With a higher price attainable, however, there exists a good reason for improvement, and the natural result is an immediate search for the cause of any defect.

At those factories where the cream has been pointed but no difference made in the price very little good has been done, clearly showing that the higher price was the reason for the improvement at other factories. The spirit of rivalry aroused between suppliers is also not without its value, and in one factory a trophy has been provided for

competition among suppliers. The great point in the system, however, is that it lets every one know just where he stands.

The difficulty of getting competent graders has been brought forward as an objection by both managers and suppliers, and some managers have suggested that such men should first pass an examination. Butter and cheese graders have been recruited from the ranks of the factory-managers in the past, and competent cream-graders can be found among the factory employees, though for a time additional work may be thrown on to the managers and buttermakers in the large factories, as extra supervision will be necessary. As a matter of fact, the quality of each supplier's cream is well known to the men on the receiving-platform of every factory where an intelligent interest is taken in the work, especially when the old system of grading has been followed. Pointing is only putting it on a more businesslike footing.

It must be remembered that in butter and cheese grading the grade is first determined and the points awarded afterwards. In the same way, the cream-grader will first decide whether a cream is choice, first or second grade, and will then award the points to indicate to the supplier its position in the class in which it has been placed. The standard adopted at different factories may vary a little, but that does not materially affect the matter, as all the suppliers to one factory will be graded on the same standard. Cream-grading conferences held during the past season have shown very little variation in the standard adopted by different managers, and visits from the Department's Instructors also assist towards uniformity. Something on the same lines among factory employees can be instituted by managers, and the experience of those who have already tried this system is that it results in a very much keener interest in their work on the part of the men.

COMMERCIAL SOUNDNESS OF GRADING.

It has been stated that the payment of a premium for choice-quality cream is economically unsound under present marketing-conditions, as the equivalent is not received for the butter when sold. That is not so. The reputation of New Zealand dairy-produce is being maintained by those suppliers who send in the choice milk and cream, and the value of that reputation during the last three years in the case of butter has been 6s. per hundredweight. Roughly speaking, 6s. per hundredweight for butter is equal to $\frac{3}{4}$d. per pound on butterfat, so that in paying the supplier $\frac{1}{2}$d. per pound for choice cream he is not getting even as much as he is entitled to. There is another aspect to this question, and that is the competition which will have to be met when an open market is restored. Those factories which had to drop cream-grading for a time during the influenza epidemic know how the quality fell away and how difficult it was to raise it again, a clear indication of the necessity for constant watchfulness.

REMINDERS.

In conclusion, the following is a summary of the points which dairymen would do well to paste in a conspicuous place in the shed to serve as a reminder :—

Don't race the cows to the yard with a dog: it will cause cowy flavour in the milk.

Don't allow the cows to drink impure water.

Don't use the milk until the cow has been calved at least four clear days.

Don't start milking without first washing your hands.

Don't start milking until you have washed and dried the cow's udder and teats, using clean cloth, clean water, and a clean bucket.

Don't use milking-machines without drawing some water through first.

Don't allow fowls, calves, or pigs in the shed.

Don't use a cloth strainer without scalding it daily.

Don't use kerosene-tins for milk or cream.

Don't use a wooden stirrer for milk or cream.

Don't use a cloth for washing utensils.

Don't use the separator-room for a general storeroom.

Don't separate in the milking-shed.

Don't mix hot and cold cream together.

Don't keep cream in the same room as an oil-engine.

Don't put the lids on the cream-cans until just before sending them away.

Don't leave the cream standing in the sun.

Don't expect to keep the separator and milking-machine clean unless you have a proper set of brushes.

Don't make the state of your neighbour's dairy an excuse for neglecting your own.

Always cool the milk as soon as it is drawn.

Always cool the cream as it leaves the separator.

Always keep milk and cream in a pure atmosphere.

Always keep milk and cream stirred with a metal plunger.

Always distribute the night's milk over all the cans in use.

Always wash cans immediately they come back from the factory.

Always skim cream so that it contains not less than 40 per cent. of fat.

Always wash the separator every time it is used.

Always wash utensils in warm water and scald in boiling water.

Always wash the milking-machine with cold, warm, then boiling water.

Always wash the milking-machine immediately milking is finished.

Always take the releaser down for washing daily.

Always take the lid off the vacuum-tank daily.

Always take the milking-machine to pieces and wash thoroughly twice weekly.

Always boil the milk-tubes once weekly.

Always wash out the vacuum-tank.

Always remember that water boils at 212° F.

Ruakura Sale of Pedigree Stock.—At the first annual public sale of pedigree stock of the Ruakura Farm of Instruction, held last month, the following prices were realized: Milking Shorthorn bulls—highest £46 4s., average £25 15s. 3d.; Jersey bulls—highest £110 5s., average £59 17s.; Berkshire boars—highest £23 12s. 6d., average £12 2s. 3d.; Berkshire sows—highest £18 18s., average £13 12s. 6d.

PASTURE TOP-DRESSING TEST IN WAIPUKURAU COUNTY.

J. W. DEEM, Fields Instructor.

THE top-dressing experiment initiated by the Hawke's Bay Farming Development Association on the property of Mr. A. F. Cook, Farm Road, Waipukurau, in August, 1917, to ascertain if by top-dressing the better grasses would be stimulated and helped to hold their own against fiorin, also to learn the increase, if any, in the carrying-capacity of the land treated, was determined on 31st December last, after having run for two years and four months, Mr. Cook being desirous of breaking up the untreated area.

The first season of the test was fairly moist, but the last two were very dry, consequently the conditions could not be considered ideal for manures to show up to the best advantage. In fact, there were times during the last two years when the area was quite devoid of feed, and the stock had to be removed. An inspection of the area in April, 1920, showed the treated area to be much greener than the untreated area. There was also far more rye-grass to be seen in the treated area as compared with the untreated, showing that the top-dressing had the effect of stimulating the better grasses.

Surveying the results for the whole period, it is found that the first two years gave an increased carrying-capacity of $1\frac{3}{4}$ sheep per acre per year for the treated area, and at the rate of 1 sheep per acre for the remainder of the period of the experiment. If the cost of carrying a sheep is taken at 9s. per year the following results are arrived at: 1917–18 and 1918–19 seasons, $1\frac{3}{4}$ sheep at 9s., £1 11s. 6d.; 1919–20 season, 1 sheep at 9s.; total, £2 0s. 6d.; against an expenditure of £1 10s. 5d. for manures*; profit per acre compared with the untreated area, 10s. 1d.

Had the different lines of sheep been weighed on and off the different areas, and the latter credited with the respective gains in meat and wool, there is no doubt that the top-dressed area would have shown a much greater profit. For instance, Mr. Cook reports that in March, 1918, forty two-tooth wethers were taken off the top-dressed area and sold for £1 9s. 8d., while none of those on the untreated area were fit for sale.

The experiment has given sufficient data to warrant further work in this direction. The association, however, should be sure of a large-enough area to test different top-dressing mixtures, also have complete control and secure possession for a period of from ten to twenty years.

* The following are details of the fertilizers used in the experiment: Japanese super, 141 lb.; Ephos phosphate, 112 lb.; bonedust, 28 lb.; dried blood, 28 lb.: total, 309 lb. of mixture per acre. The cost per acre (in 1917) was—fertilizers, £1 4s. 6d.; freight, 1s.; cartage, 1s. 5d.; harrowing, 1s. 6d.; drilling, 2s.: a total of £1 10s. 5d. For previous reports on the test see *Journal* for May, 1918, and November, 1919.

ORCHARD TILLAGE.

IMPLEMENTS AND THEIR USE.

T. E. RODDA, Manager of the Arataki Horticultural Station.

PLOUGHING AND DISKING.

In the average orchard the soil should be ploughed at least twice a year. At the end of autumn the land should be turned over, and left in the furrowed state during the winter. The earth should be banked to the trees, and the land finished in the centre of each row. This ensures good drainage, and does not allow the stagnant water to collect near the base of the trees.

Various makes of ploughs are used for this purpose. One with a long head-rack or bridle and shiftable handles, either single or double furrow, such as the Harvey (an Australian-made plough), should be used in opening out. These ploughs are so constructed that the team and driver are clear of the spreading branches while the implement is turning the soil close in to the trunks of the trees. By turning the draught-chain and bridle to the reverse side the plough can be made to turn the earth away from the trees with corresponding ease. Such an implement greatly reduces the danger of barking the trunks and injuring the branches. Similar ploughs of American manufacture, such as the Oliver, the John Deere, and the Massey-Harris orchard and vineyard ploughs, are also recommended. They are somewhat lighter in draught and somewhat cheaper in price, but probably they do not wear so long as the Harvey. The use of special orchard harness also reduces the amount of branch injury, and I would advise any grower, large or small, to procure such gear: it will be money well invested. There are various makes of orchard harness on the market. Several makes were recently demonstrated at an orchardists' field-day at this station, those of Holden and Frost and Simpsons Harness Ltd. meeting with approval in the order named. When the soil is turned to a sufficient distance to ensure branch clearance, double- or single-furrow ploughs of ordinary make can be used, or the special orchard ploughs can be used until the whole orchard is completed.

At the approach of spring the land should be again worked, when weather conditions are favourable. In the case of light friable soils probably all that will be necessary at this season will be a thorough disking and harrowing, but in heavy soil it is advisable to give the land a stroke with the disks, and then plough it away from the trees. The following year all ploughing should be done at right angles to the previous furrows, so as to ensure all soil in the orchard being stirred by the plough periodically. After completing spring ploughing, the disk harrow should be again brought into use, and a portion of the soil returned towards the tree-trunks by using the implement as a cut-away. This is in order to obviate the danger of injury to the root-fibres by the drying influences of harsh winds, which are often prevalent at this time of the year. If the winds are exceptionally severe it is advisable to waste no time in working the soil back towards the roots.

FIG. 1. SINGLE-FURROW HARVEY PLOUGH TURNING FURROW FROM THE TREES.

Turning the first furrow after the work has been carried forward as far as possible with an ordinary double-furrow plough. Three furrows more can be cut without injury to the trees.

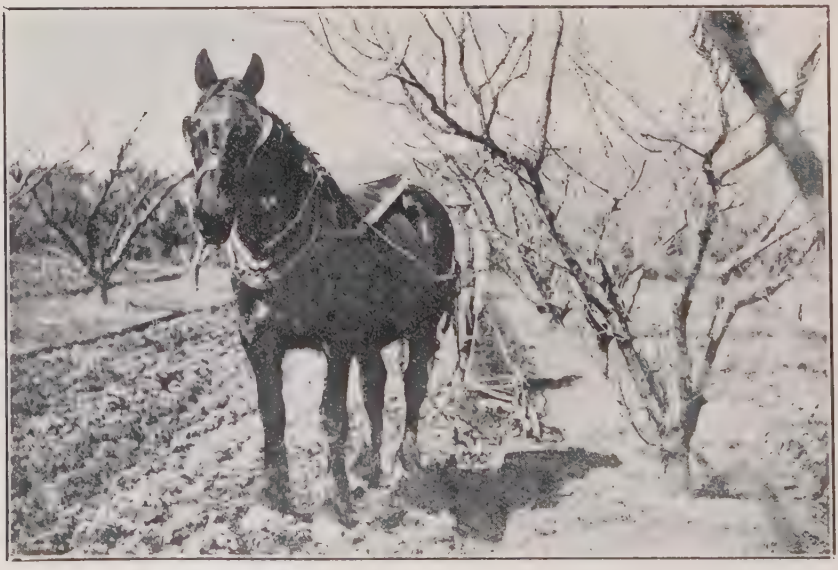


FIG. 2. FRONT VIEW OF SINGLE-FURROW HARVEY PLOUGH, SHOWING SIDE HITCH.

Horse equipped with Holden and Frost's orchard harness

FIG. 3. FRONT VIEW OF PLANET JR. SCARIFIER NO. 41, SHOWING HOW TEAM IS ATTACHED BY SIDE HITCH.

Centre of implement indicated by X between legs of off-side horse. Point of draught now 15 in. to left of centre. Note how close implement is forced in to butts of the trees while horse walks clear of limbs.

FIG. 4. REAR VIEW OF PLANET JR. SCARIFIER NO. 41, SHOWING METHOD OF ATTACHING HARROW TO COUNTERACT SIDE DRAUGHT.

Driver's seat is fair over centre of implement, while point of draught is 15 in. to left, where pole is attached.

An orchard disk should be so constructed that the gangs can be made to throw the earth towards the trees or draw it away from them, and the frame should be so designed that it is kept as low to the ground as possible, and allow the width between the gangs to be easily and readily altered when it is desired to do so. When fully extended one gang of disks will stir the soil close up to the trunks of spreading trees, while the horses are driven clear of the branches. There are numerous makes of orchard disks on the market, including the Barger, the Osborne, and the Harvey. They all work much on the same principle, and ensure effective cultivation, while the danger of tree-injury is reduced to a minimum if they are operated by a careful driver.

SCARIFIERS AND SCARIFYING.

During the growing-period, after spring disking, the soil should be stirred at least once a month with a scarifier, in order to prevent the growth of weeds and to retain that condition of soil-mulch which prevents rapid evaporation of moisture and accelerates the action of nitrifying bacteria.

Various makes of scarifiers are obtainable, but perhaps the two most popular are the Planet Jr. and the Harvey low-down spring-tooth cultivator. The former is a good all-round implement, especially the large (No. 42) thirteen-coulter machine, which stirs the soil for a width of 7 ft. 6 in. at a passage, provided the extensions are used on the outside of the wheels. To work this implement effectively in heavy land three good horses will be required, but two can work the machine comfortably if the extension coulters are removed. It then stirs the soil for a width of 5 ft. 3 in. at a passage. On the other hand, if the extension coulters are retained and five of the centre coulters are removed the implement can be operated easily by two horses, and made to stir the soil close to the trunks without fear of injury to the branches either by chains or swingletrees. When so converted it works on the principle of the orchard disk. To reduce the danger of root-injury it is advisable to set the two coulters nearest the tree lighter than the others. This can be done by slackening off the set-nut of the clamp and lifting the coulter-head in the socket on the back bar of the frame, retightening the nut when the desired adjustment has been obtained. This machine is to be recommended for the person or persons who have a large area planted in fruit, but it will hardly pay the man who has only a small holding to keep three horses to operate it.

An implement that is much liked by the orchardist who can keep two horses to do his work is the Planet Jr. catalogued as No. 41. This implement is equipped with eleven coulters, and is so constructed that the team can be hitched 15 in. to the left-hand side by unscrewing four nuts, moving pole and swingletrees bodily from the centre, and placing bolts in the holes provided for such adjustment. This alteration of the point of draught will force the implement under the spreading branches, and stir the soil close to the trunks of the trees, while the off-side horse walks clear of the branches. This side hitch creates some side draught, however, which is not desirable, owing to the fact that it is rather uncomfortable for the team. To overcome this I find it is a great advantage to attach with a chain to the implement one leaf of an ordinary tine harrow, just behind the second coulter, counting from the left. When the proper point of adjustment has been attained

FIG. 5. PLANET JR. NO. 8, FITTED AS A NINE-TOOTH MACHINE, SCARIFYING CLOSE UP TO SIX-YEAR-OLD TREES.

Note handles turned to side to ensure branch clearance.

FIG. 6. SHOWING CONSTRUCTION OF PLANET JR. SCARIFIER NO. 8 FITTED AS A NINE-TOOTH MACHINE.

Stabilizing guides marked S. Points marked X show where framework to carry extra four teeth is bolted on to ordinary No. 8 five-tooth machine

the scarifier will work as evenly and as straight as if the team were pulling from the centre of the frame. (See Fig. 4.) The Planet Jr. No. 46 is an implement of later design, which has certain advantages that No. 41 does not possess. One outstanding feature is the elimination of the depth hand-levers by substituting ones that can be operated with the foot.

Smaller types of implements are necessary for the small orchardist whose holding can maintain only one horse. For this class of grower I consider the most suitable machines are the Harvey and the Planet Jr. No. 8. The Harvey spring-tooth cultivator is an ideal implement for close cultivation under spreading trees. It is fitted with a patent attachment by which the machine can be quickly changed from the ordinary machine which follows the horse to one that will work to the side under the trees while the horse walks clear of the limbs. The machine is set over under the trees by simply dropping a link in the draught-chain and setting the disk, which acts as a rudder at the rear of the machine, at the desired angle. This implement is made in sections of nine tines to the section, and is so constructed that one or more sections can be linked on if desired. One good strong horse can easily pull one section.

For the orchardist starting in a small way the No. 8 Planet Jr. is an invaluable implement, especially if intercropping is carried on until the trees come into bearing. Used as a five-tooth machine it is eminently fitted for cultivating potatoes, peas, beans, and various sorts of farm crops. For cultivating close up to small trees the cultivating width of the machine can be increased to 47 in. by adding four extra teeth. When so fitted and expanded to its maximum width it will work without the operator holding fast to the handles, provided the stabilizing-guides are attached to the two outer teeth at the rear (see Fig. 6). This is a very decided advantage over the same implement operated as a five-tooth machine, especially when cultivating close up to the rows of young trees. It leaves the operator with both hands free to guide the horse, a feature that will be readily appreciated when driving alongside young trees during their first and second seasons.

All the above-described implements do really effective work, and are to be recommended for all classes of soils. One thing I would advise the inexperienced to guard against, and that is to never let the weeds get too well established before using the scarifier. One stroke of the cultivator in time—just before the weed-roots have obtained a firm grip of the ground—will be of more value than two or perhaps three strokes of the same implement if the operation is long delayed.

HAULAGE POWER.

The horse supplies the general haulage power for all the implements just described. Specially designed motor-tractors are doing good work in many of the fruitgrowing districts in other parts of the world, but at the present time there are very few, if any, of a really suitable type to be found in our New Zealand orchards. The cost of tractors is still beyond the reach of the average orchardist. Although the cost should be reduced considerably when shipping freight-rates become normal, until such time arrives the orchardist will probably be wise to consider that the horse supplies the most reliable and economical tractive power that he can use.

WORK FOR THE COMING MONTH.

THE ORCHARD.

THE essential need of a more thorough organization of the fruit industry of the Dominion has been generally recognized and discussed by both grower and consumer alike for some time past, but although considerable progress has been made in general organization, resulting in the industry being placed on a very much more satisfactory footing than previously, the all-important factors of distribution and marketing are in quite as unsatisfactory a state as ever.

The market price of fruit this season is lower than usual—much lower than retail prices suggest—while the cost of production has considerably increased. The grower's concern in this matter has been and still is the bringing into existence an organization that will result in materially increasing the consumption, and at the same time return to him a greater proportion of the consumer's shilling than has hitherto been the case. The consumer's interest in the matter has been to see it adjusted in a way which would enable him to readily obtain fruit of a reliable quality at a more reasonable price.

Although the desires of both ends of the industry are thus largely identical, the solution of the problem is wholly a matter for the fruit-grower, and it is to be hoped that the forthcoming conference of the Federation, which opens in Wellington on 26th instant, will give this matter its earnest attention, as well as those problems connected with the export of fruit which presented themselves this season, with a view to placing both phases of the industry on a more satisfactory footing before next season.

FIRE-BLIGHT.

The work of eradicating fire-blight from the affected areas of the Auckland Province is progressing satisfactorily. In addition to all available Horticulture Division officers a large temporary staff is still engaged on inspection, cutting out of diseased wood, and the destruction of badly affected trees. This work will probably be completed by the end of the month. A concentrated effort will again be made in the early spring for the purpose of detecting and removing all hold-over cankers which may have been overlooked.

—*J. A. Campbell, Assistant Director of the Horticulture Division.*

AUCKLAND.

Growers who are anxious to get other work well in hand may proceed with stone-fruit pruning operations during June. Any draining-work that requires to be done should be attended to. Work among shelter-trees which require trimming, or temporary belts which require thinning out or lopping, may be carried out before the rush of pruning and winter spraying comes. In cases where the preparation of land for planting is yet undone, and weather conditions permit, opportunity should be taken of putting this work through. Autumn ploughing

in the orchard should now be completed. If any repairs are needed to glass-houses or sheds, these should not be overlooked whilst there is a general slackness in the more important work. Replenish stocks of spraying-materials and manures, and overhaul sprayers. —*J. W. Collard, Orchard Instructor, Auckland.*

HAWKE'S BAY.

The present is an opportune time to review the results obtained during the season just closing, and formulate a plan of campaign under which to conduct the coming season's efforts. The effects of pruning operations will be fresh in mind, and may be pursued or modified as results have indicated necessary. The fungoid diseases and insect pests should not be overlooked, and records checked of the control measures applied. It is by a close examination of all these details that one is able to define as something concrete the results of experience.

General orchard ground operations, such as ploughing, draining, and cleaning existing drains, should be undertaken when the soil conditions are favourable. The month is a very suitable time to attend to the thinning, topping, or trimming of shelter-trees. Many poplar belts throughout the district are too thick. This state is no doubt desirable when the hedge is young and gives immediate shelter, but the stage of growth arrives when thinning becomes necessary to ensure a desirable permanent belt. This work may be carried out when soil conditions are not favourable to land work. The wet days may be profitably spent in cleaning up the packing-sheds, overhauling implements and spraying plant, &c. The pruning of fruit-trees will be the main work during the dormant season. Stone-fruits are usually in a dormant state before the pome fruits, and the pruning of such should be pushed on as rapidly as possibly. Cut out all dead wood, remove all mummified fruits, and rake up all prunings and destroy.

Where the land has been properly prepared, and when the soil conditions are favourable, planting may be done. Planting operations should not be carried out when the soil is saturated. However, if the trees come to hand at that time they should be taken from the bundles and trenched in temporary quarters. —*W. H. Rice, Orchard Instructor, Hastings.*

NELSON.

During June orchard pruning is generally commenced. It is a subject about which a great deal has been written, and every "system" has its advocates. At the present moment it is advisable to carefully consider the trees to be pruned. There is not a row of Sturmers in any orchard which does not present a variety of problems. Here, we have a vigorous tree in good condition fit to carry a maximum crop; there, is a backward tree inclined to be stunted in its growth; here again, is a good tree that has had a leader or two broken out during summer. There are dozens of types of this one variety of orchard-tree, and three or four are to be found in any orchard. The skilful pruner will consider these: The vigorous trees will be pruned with a view to getting a maximum crop; the weak trees with a view to invigorating them; the broken tree with a view to building it up again; the tree with a dense top will be pruned with a view to letting the light in, so that the lower limbs may be clothed with fruitful spurs and laterals. Under these circumstances our favourite "system" will sometimes have to be let go; a place will be found for "hard" pruning as well as "light" pruning, and even the old-fashioned lateral pruning cannot be ignored. This, to some, may look as if our carefully-thought-out principles are cast to the winds; but is it not adding to the science of pruning the art of its application?

Where grafting has to be done later, collect the scions when pruning, and heel them in in a shady place.

The fruit-store will be a busy place during the month. Inspect the stocks at frequent intervals and note developments. On cold nights freely ventilate the stores, which will be easily done if the fruit is properly stacked. The idea is to let off the gases generated by the fruit and reduce the temperature.

On the market one often meets with Sturmer apples in the month of June, and Jonathan and Munroe in October and November. This generally is bad practice, and to the detriment of grower and consumer. If the storing has been fairly considered the right varieties should be easily available. By the end of June the last of the Cox Orange should be despatched; and probably in July and August we should see the last of Jonathan and Munroe respectively, leaving for the spring months Sturmer, Delicious, and the like. We are anxious that the consumer should cultivate his taste and get the right apple at the right time. How can he do this if we do not supply them in the right order?

"Prevention is better than cure" is a proverb never out of season. If an enemy were to allow diseased fruit to drop into your orchard, what indignation it would arouse! Do not be your own enemy; do not allow waste fruit to accumulate about your store. Feed it to the pigs before it is waste.

Where planting is to be done inspect the trees carefully on arrival. If moist and well packed they may keep all right for a few days in the package, in a moist shady position. As a rule it is best to unpack them and carefully heel them in in the open ground. Plant them out when the land is prepared and the soil in good friable condition. Plant them firmly.

—W. C. Hyde, Orchard Instructor, Nelson.

MOTUEKA.

The main work now to be put in hand is the winter pruning of fruit-trees. Practical instruction on the spot will be given as far as possible, but a few general hints may be given for the guidance of pruners. Firstly, use a good pair of secateurs and keep a fine edge on the blade. Aim to keep the proportional symmetry of the trees so that ventilation and sunlight may be evenly admitted. Remove any diseased wood, paying particular attention to powdery-mildew infection. Destroy by burning all diseased portions removed. For the future well-being of the trees it is better to cut too hard than too light, although both extremes should be avoided. Peach and nectarine trees require a much harder system of pruning than generally practised in this district; plenty of new wood must be induced each year for the following season's fruit. Mark out proved unprofitable varieties for removal; every season they are left may be counted as a season lost; they should be replaced as early as possible by reworking or the planting of better varieties.

Winter cultivation should be put in hand as soon as possible. Ploughing on to the trees and leaving the furrows turned up to the action of the winter frosts is beneficial; this also provides an open furrow in the centre of the rows of trees to take away surplus water.

General draining-work should be attended to, new drains being made where required, and established drains kept in proper working-condition.

Preparations should be made for the eradication and control of insect pests by the application of a heavy dressing of red-oil emulsion, 1–8, during the dormant season. Where the infection is very bad two dressings may be applied, one to be made immediately and another just before the buds burst.

—W. T. Goodwin, Orchard Instructor, Motueka.

CANTERBURY.

After a thorough clean-up of the orchard in the way of stacking away fruit-cases, clearing out drains, cutting and trimming shelter-belts and hedges, the main work of the orchardist at this season of the year will be pruning.

Stone-fruit pruning should be well advanced by this time, and completed before a start is made with apples and pears. As the pruning season is a fairly long one it is advisable for growers to spray their trees and not cut in any haphazard way. Growth made during the season—fruiting wood, spurs, and laterals—should all be considered and cut accordingly. Consideration should also be given to the local conditions prevailing as well as to the generally accepted principles of pruning. It is hardly necessary in this district to warn growers against excessive pruning, as in many cases insufficient wood is taken out. As the majority of apple-trees spur very freely in this district attention should be given to the thinning-out of these spurs, especially in full-bearing trees. Better-quality fruit will be the result.

In regard to cool-stored fruit, growers have a splendid market right at home, and it is for them to market their fruit advantageously. When taking fruit from the cool stores go through it systematically and conscientiously, and only place first-class fruit on the market.

Although spraying for the majority of insect pests can be delayed for a time, it is as well for growers to give their stone-fruit trees an application of 8–6–40 bordeaux, especially where leaf-curl, die-back, and rust have been prevalent. In some cases, where woolly aphis and red mite have been bad, it would be as well to make two sprayings of red oil during the dormant season. If so an application at strength 1–8 towards the end of the month will do much good. On the whole, orchardists in this district are to be congratulated on the clean state of their orchards. I am sure that this is directly due to the extra spraying

done last winter and the thoroughness with which it was carried out. A little additional this season will mean even cleaner orchards next year. Do it.

—*G. Stratford, Orchard Instructor, Christchurch.*

OTAGO.

Advices to hand (at end of April) indicate the need for care in the storage of late varieties of apples, as black-spot has begun to develop in consequence of autumn rains. To prevent this disease spreading in the cases it is necessary to have plenty of ventilation, during the first few weeks particularly. Pick fruit dry into seasoned cases, and stack in such a way that the air will pass through them freely. All affected apples should be kept apart from the clean fruit.

Pruning will be the next important operation in the orchard, and the best men to undertake this work are those who have carried out the picking during the season, provided they are competent. The men who are constantly in the orchard and at all observant will have noticed the peculiarities of the different varieties. Some will have been overloaded, due perhaps to insufficient pruning last winter, while others will have gone to rank growth, perhaps due to too severe pruning previously. Then, again, the method of fruit-bearing must be studied. Most varieties will bear some fruit on laterals as well as spur freely, but all will not bear heavy crops if treated solely for spur bearing. Some varieties of apples and pears also will spur freely as the trees decrease in vigour, but while they are growing rankly laterals must often be left in to start them bearing. The same applies to stone-fruits, and these must be studied closely if the best results are to be obtained.

Growers will all have heard of the outbreak of American fire-blight in the North Island, and it behoves all to keep a sharp lookout for any sign of this disease. Should any grower find any suspicious signs I shall be glad if he will draw my attention to it at once in order to enable precautions to be taken.

—*J. H. Thorp, Orchard Instructor, Dunedin.*

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

MANAGEMENT OF THE BREEDING-STOCK.

WHERE it is intended to commence hatching in July (which is a good time for bringing out the chicks of the heavier breeds) preparations for this important operation should be got under way at once. The breeding-pens should be mated up with as little delay as possible, in order that the birds may be well settled down before their eggs are required for hatching purposes. They should also be put on a special diet. The proper feeding of the parents is all-important if success is to be assured in the hatching and rearing of their progeny. The ration should be plain, and on no account should the birds be forced for heavy laying.

In this respect it is not as well understood among poultrymen as it should be that many of the troubles met with in the hatching and rearing of chickens are due to improper feeding of the parent birds. The most common error made is to feed to excess rich foods, such as meat, milk, &c., with a view to securing a high egg-yield. In breeding operations it is not a record number of eggs that should be looked for, but rather the greatest number of fertile eggs and the production of a high percentage of healthy vigorous chicks.

It is often said, and rightly so, that if given a good sturdy chick half the trouble of rearing it is over. To bear out this contention one

has only to study the behaviour of chicks bred from forced parents and those that are not. The former appear to have few, if any, natural instincts, except perhaps to make a continual distressed chirp as indicating that all is not well with them. They are usually slow to commence eating and to take exercise, while their general appearance denotes a delicate condition. As a rule, heavy mortality takes place from the fifth to the eighth day. The food, the brooder, and many so-called mysterious diseases are usually blamed for the disaster, whereas in many cases mismanagement of the breeding-stock is alone responsible. In such cases it will usually be found on making a *post mortem* examination that the liver presents an unhealthy yellow appearance, showing that the little one had been hatched out in an unhealthy condition. On the other hand, the chicks produced from parents fed and managed in a proper manner will give evidence of possessing strong constitutional vigour immediately they leave the incubator. They soon learn to eat, to take exercise, and to know where they can get a warm-up when required. In short, their behaviour denotes a healthy, contented condition.

Of course, it is not to be inferred that because a chick is hatched out in a healthy robust state it will necessarily thrive, or even live, irrespective of the attention it receives during the brooder stage. Success in rearing brooder chicks depends on numerous details being observed, and if these are departed from failure is inevitable. It is, however, safe to say that correct management of the breeding-stock lies at the base of this important work.

It is now generally recognized that it is an unwise policy to feed wet mashes to breeding-stock. The best plan is to provide at all times a mixture of dry grains, such as wheat, oats, and maize. This should be fed in deep scratching-material, which is an excellent means of inducing exercise—an essential for the maintenance of a healthy flock. This, of course, applies only where birds are kept in confined quarters, for where free range is available nothing can take its place in providing healthy exercise and ideal conditions for breeding-birds. Where a whole-grain ration is provided it is of the first importance that hard grit be always available to the birds for the purpose of aiding digestion. Green food is another essential that should be daily and liberally provided.

Do not on any account allow the breeding-hens to become too fat, as a strong chick cannot be produced from an overfat mother. A good plan is to periodically handle the birds when on their perch in order to ascertain their condition. Too much maize is apt to have an over-fattening effect; therefore if the birds give evidence of becoming too fat the exercise should be increased and the amount of maize reduced.

In mating birds never use a male unless he is in perfect health and condition. It is always a mistake trying to doctor up for the breeding-pen a bird that has apparently recovered from some disorder. To ensure the most satisfactory results there must be no question as to the constitutional vigour of the parents.

Another important matter that should be now attended to is overhauling the incubators and brooder appliances. Everything should be done to rectify anticipated trouble, such as providing fresh burners for lamps where worn out, new connecting-rods for the incubators where

the old ones have become bent, or new thermometers for those which have been broken. It is also a good plan always to have a good stock of lamp-wicks of the correct sizes to fit the lamp-burners. It must be remembered that duplicate parts of appliances are often difficult to secure in these times, so that failure to attend to these little details now may cause endless worry and loss of time at a later date.

NEW BREEDS.

Notwithstanding the present acute shortage of fowl-feed, and the scarcity of the fresh-egg product, it is to be regretted that there is a great tendency on the part of many poultry-keepers to take up any new, untried breed (from a utility viewpoint) which has merely special feathering, &c., as its principal recommendation. It is a much safer policy to adhere to the well-known breeds which have been so well improved as utility stock, especially as some of the new types have yet to be developed for standard requirements before even the work of selection to secure a utility standard is attempted. The endeavour to advance breed character and utility qualities at one and the same time is an almost impossible task. It is most important at the present time —from the individual as well as the national point of view—that we should do all in our power to preserve at a high standard the breeds we have developed to suit our special requirements.

THE APIARY.

G. V. WESTBROOKE, Apiary Instructor.

OFF-SEASON WORK.

At this season of the year the bees should be all prepared for their winter rest. There should be no manipulation of the hives beyond lifting the covers occasionally to see that the mats are dry. Nothing is more detrimental to the bees than to have damp mats—in fact, it would be better to have no mats at all than allow them to remain wet. If the covers are sound there will be no risk of any such conditions. It is, however, always a good policy to have a few spare covers in good repair; then when leaky ones are discovered they can be replaced by the sound ones. Those removed can be repaired when convenient, and be in readiness for future use. One of the best methods of repairing faulty covers is to first give them a coat of paint, then spread tightly over it cheesecloth or similar material, and finally apply another coat of paint over all.

All supers that are free from bees should be removed to the store-room. They can then be given a fresh coat of paint in readiness for next season's crop. Where no fumigator comb-room is available empty combs should be left in supers and tiered up, placing them on a solid foundation, with a queen-excluder at the top and bottom of each tier to exclude mice. A few carbon balls in each pile will assist in keeping away the wax-moth.

The comparatively quiet months of the winter should also be utilized for overhauling all material not in use. The extractor should be carefully cleaned, and given a light coating of vaseline to prevent rusting. Any odd scraps of wax or broken comb should be melted down, and all work that it is possible to do in the way of preparation for next season should be undertaken.

THE ANNUAL CONFERENCE.

Beekeepers may be reminded that the annual conference of the New Zealand Beekeepers' Association will be held at Christchurch on 9th, 10th, and 11th June. All persons interested in beekeeping are welcome to attend.

VITICULTURE.

S. F. ANDERSON, Vine and Wine Instructor.

NATURAL AND ARTIFICIALLY SWEETENED WINES.

A NATURAL wine is one made from ripe grapes containing generally not less than 20 per cent. of natural sugar. They may in favourable years contain a higher percentage than this, but have never been known to contain a higher percentage of grape-sugar than can be transformed into alcohol by fermentation, resulting in the wine being dry. The alcoholic strengths of these wines have ranged from 10 to 14·5 per cent. by volume, corresponding to 21·9 and 26·0 per cent. of proof spirit. Wine so made is a natural wine, because no addition whatever is made to the natural product of the grape. It contains all the fruitiness of the grape with sufficient alcohol to keep it, and improves by age up to ten years. It is at its best between four and ten years. Although, compared with other alcoholic beverages, the strength may appear high, the other ingredients of the wine, such as the tartaric, citric, and tannic acids, and other matters only found in combination in wine, go to make a natural wine the healthiest and least intoxicating.

A wine to be sweet and yet to keep must have a much higher percentage of alcohol than a natural dry wine. The sweet wines made from New Zealand grapes therefore require fortifying up to 28·9 per cent. of proof spirit. At less than this they are liable to change with variation of the temperature in which they are kept. Australian, African, and other imported sweet wines go as high as 34 per cent. of proof spirit. Pure spirit is the only lawful means of preserving sweet wine. To add any antiseptic is forbidden by the regulations of our Pure Food and Drugs Act. There are several methods of making sweet wines. In New Zealand it is customary to add sugar and alcohol to the ordinary dry wine. This is too often done in a haphazard manner by the vigneron, the result sometimes being a wine not keeping well, or being too fiery or too sweet.

The following method may be taken as a proper basis to go on: t is assumed the wine to be sweetened and fortified has been made

from grapes that showed by Guyot's saccharometer 20 per eent. of natural sugar—that is, in every 100 lb. (or 10 gallons) of the must there is 20 lb. of sugar. After fermentation the resulting wine will contain 11·76 (20 ÷ 1·7) of absolute alcohol by volume, equivalent to 20·6 of proof spirit. But this is a dry wine, and it is required to be sweet. An ordinary sweet wine contains from 6 to 8 per cent. of sugar, and here we will calculate on sweetening it to 8 per cent. This is equal to 8 lb. of sugar to every 100 lb. (or 10 gallons) of the wine. This sugar should be dissolved in a portion of the wine in a copper boiler by heating it till it steams—that is, about 140° F. It must not boil, as that would impart a cooked flavour and possibly make the wine more difficult to clear. When quite cool it is then put into the wine and the whole thoroughly stirred.

The wine is now sweetened, but for keeping it requires additional alcohol. As already indicated, to keep a sweet wine from changing its condition it must have at least 16·30 of absolute alcohol by volume, or 28·9 of proof spirit, in it. The additional alcohol required as proof spirit may be calculated as follows: 28·9 — 20·6 = 8·3 × 100 = 830. 100 — 20·6 = 79·4. 830 ÷ 79·4 = 10·45 (say, 10½ gallons). Should the wine contain over 20·6 per cent. of proof spirit, or the spirit used be over or under proof, the computation must, of course, be made accordingly.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

EARLY cauliflowers and cabbages are an important crop and deserving of a little extra attention. In the northern districts plants should be ready for setting out early in June—that is, plants from the sowings made at the end of March. It has been said before that it pays to prick the plants out as soon as they can be handled, but there are few who do so. Where this has not been done care should be taken that the plants do not become drawn by being crowded in the beds. They are very liable to become weakened in this way during the period of short days we are now in. Weeds should be rigorously suppressed, as they create a dampness about the stems and a general weakness of the plants. A little air-slaked quicklime dusted among the plants occasionally helps to keep them sound. If insect pests are present spray with Vistolene. The spray is best applied by means of a pneumatic sprayer. These machines deposit the spray in a fine mist and use very little material, which is an advantage at this season.

Peas may now be sown in early districts, but only dwarf varieties. In some parts slugs and snails are very troublesome by the time the plants from this sowing should be growing well. In large cultivations this trouble is not much felt, but in domestic gardens where a few rows are in close proximity to other crops that afford good shelter for slugs the trouble is sometimes very considerable, the long nights being in

favour of the pests. In such cases the trouble can be overcome by supplying sticks for the support of the pea-haulm—slugs and snails are troublesome only when the haulm lies on the ground. Birds are another trouble in many places, but they never touch peas after sticks have been put in. In any case it is worth while to give sticks where it can be managed, for even dwarf peas are greatly improved thereby.

Broad beans should be planted by the middle of June. This is a matter of ordinary routine, and provides the early crop. In all mild places lettuces may be planted all the year round, during the winter months selecting the warmest position for them and usually planting on raised beds. Endive, being hardier than the lettuce, often gives better results.

Winter rhubarb may still be planted. Though, of course, the produce cannot be great this coming winter, it is worth while to plant, as stalks can be taken as soon as they grow, in which respect the plant differs materially from the summer variety. Except in places where the winters are severe, it is not now necessary to force rhubarb for winter use. The winter variety is now coming freely into the market, and will no doubt reach the southern towns.

Seakale may be forced at any time from now till the plants start growing in spring. Books on English gardening describe methods for lifting the crowns and forcing them under glass in specially constructed houses. These methods are now applicable in this country. The clumps should be forced where they are growing in the open ground. All that is required is to clear off the old leaves, give a sprinkling of lime and soot to kill slugs and keep wireworms out, and then cover the clumps with a benzine-case with the bottom (which will then be the top) loosened so that it can be lifted. Cover about 1 ft. deep with fermenting stable dung. The heads will be ready in about fourteen days. The bed should be forced in batches. This is a crop no good garden should be without; it makes a particularly attractive and delicate dish. The plants will grow in any odd corner of the garden and are very little trouble. The manure after the crop is taken is available for use on another part of the garden.

Asparagus-tops should be cut down before the ripe berries fall. Cut close to the ground so as not to leave snags of the old stems. At this time no other attention is required except to lightly loosen the surface soil. A tine hoe, often termed a "drag," will usually be the best tool to use.

Vacant ground should not be allowed to grow weeds. These rob the soil, and form a harbour for vermin, which give endless trouble in spring when seeds are sown. Turn the soil over and give it the benefit of sun and air.

SMALL FRUITS.

Loganberries.—The cultivation of this fruit is so rapidly extending that it will apparently in the near future become the most extensively grown of all the small fruits. The fruit is best described as being a vastly improved blackberry, but with much greater productivity. It does not appear to be subject to any pest, either fungoid or insect;

its growth is easily controlled; and as it does not form suckers and rarely seeds it is not possible for it to spread and become a noxious weed. The plant is not particular as to soil, though best results are naturally obtained on fairly good, moisture-holding land. Propagation is by layers from the young rods, and by cuttings. The cuttings are made from young rods taken in winter and cut into about 12 in. lengths. These should be planted firmly, all but the two top buds being buried in the soil. Propagation by cuttings should be in nursery beds, not *in situ*. The habit of the plant is to make very long runners or rods, which bear fruit the season after they are made. Fruit is borne on sprays that emerge from buds formed in the axils of the leaves, every matured bud being capable of producing a spray of fruit. The ends of the rods, being late growth, do not mature the buds; therefore a length is cut off when the rods are tied in place. In open-field culture the rods are only allowed to bear fruit one season, being cut out when fruiting is over, and new rods, which are made each season, tied in to take their place. For training by the trellis system the plants are set 8 ft. apart each way, and each row should have a post-and-wire trellis, the posts being set at every fourth plant. Posts should be 7 ft. long, 2 ft. being in the ground. Three wires of No. 12 gauge are fixed, one on top, the others one-third and two-thirds from the ground. An improved trellis has two sets of wires, one on each side of the posts. In this case the bearing-rods are tied to one set and the young rods as they grow are trained to the opposite set. The gain is ease in handling, and the young rods do not crowd and shade the bearing-rods. It is noticed that in some gardens the rods are tied to stakes in the way raspberries are supported. This plan is bad; bearing cannot be satisfactory unless the rods are trained to a horizontal position, or nearly so.

Raspberries.—A fairly good and moisture-holding soil is necessary for raspberries; it is useless to plant on dry soil. Several different plans of planting are in vogue, but that most frequently adopted is the hill method. Clumps of three are set 5 ft. apart from centre to centre. The three sets in a hill are planted in a triangle, each plant about 9 in. apart. Young suckers taken at a distance from the stool are best for planting. These suckers will not have much top, but will have a good bunch of roots. After planting cut the tops down to within 6 in. of the ground as a maximum to leave. A good crop should be obtained the second year. Established plantations should now be put in order. Surplus suckers should be forked out; cutting them off leads to multiplication and future trouble. The canes that have borne fruit are now dead and should be cut out. Cut as close as possible to the stool, so as not to leave a stump of dead wood. If the canes are infested with scale insects they should be sprayed with lime-sulphur, 1–15, which will also act as a fungicide. The best varieties are Antwerp, All Summer, Northumberland Fillbasket, Superlative, Semper Fidelis, and Fastolf.

Gooseberries.—Any moderately good soil will grow this fruit, though they do best on what is considered good vegetable-garden soil. The gooseberry does not succeed in the warmest parts of the Dominion. Bushes are raised from cuttings, which should be about 15 in. long. All buds except four or five at the top should be cut clean out, so as to prevent suckering. Bushes should be trained to a single trunk

with at least 8 in. without branches. Four main branches are sufficient; more than that number is too many. The first winter after planting these four branches should be headed down to 10 in. or 12 in. From each shortened branch two new leaders should be allowed, these being in their turn shortened back as before, and so on in after-years till the bushes have attained full height—about 4 ft. When pruning established bushes the aim should be to keep the centre open, so that the sun can reach all parts of the bush, and to keep the growths far enough apart to enable easy gathering of the fruit. This condition allows a free passage for light and air, promotes strong, fruitful growth, and enables a bush to bear good fruit on all its parts. Crowded bushes are wasteful; they bear good fruit only on the outside, and give a lot of trouble in gathering. The young shoots require different treatment according to their position and strength. Occasionally very strong shoots appear on the lower part of a bush. These should be cut clean out, taking care to cut hard into the old wood so as to leave no basal buds, which would each develop into another strong shoot and make the condition worse than before. Strong and moderately strong shoots should merely be tipped so as to take off the latest growth, which is not mature. Weak shoots may be cut harder in proportion, and very weak shoots, as well as all on the lower parts of the bush, should be cut back to spurs about ¾ in. long. This is done because the lower part of the bush is the weakest, and restricting the number of berries enables the bush to bring them to the same perfection as a greater number on the higher parts. There are a large number of very fine varieties, and it is not an easy matter to distinguish a few. The favourite with market-gardeners has for some years been Farmers' Glory, a very prolific variety that makes a good bush. The fruit is large and long in shape, and red when ripe. Other good varieties are: Green—Green Overall, Gregory's Perfection, Marigold, Jolly Tar, Alarm; red—Billy Dean, Champagne, Crown Bob, Ironmonger, Ploughboy, Red Rough, and Warrington (for preserving), Roaring Lion, Whinham's Industry, St. Clair; white—Alma, Whitesmith, Lady Leicester, Careless, Postman, Bright Venus; yellow—Broom Girl, High Sheriff, Pineapple, Drill, Gunner, Smiling Beauty.

Red Currants.—Fruit is borne only on spurs on wood that is two and more years old, never on young shoots. The aim, therefore, is to produce branches that will carry spurs. It is important that the bushes be trained so that light can reach every part, for every part from the base of the branches to the top is capable of bearing fruit, but will not do so if crowded. Cuttings should be prepared as described for gooseberries, but only three main branches should be allowed for a start. Heading-down is the same as for gooseberries. At the annual pruning all shoots that are not leaders are to be reduced to spurs about ¾ in. long, but there is some preliminary shortening done during summer, which will be described at the proper time. Success cannot be secured unless the right varieties are planted. There are varieties that do well in other countries but will not bear fruit in this country. Among them are Raby Castle and American Wonder. Varieties that succeed are La Versailles, Fay's Prolific, Chenanceau, Bertyn's No. 9, Cherry.

Black Currants.—A cool climate and deep strong soil suit this plant; it is quite useless to plant them in dry soil. In every part of New Zealand borers give a good deal of trouble, and it is impossible to profitably grow the fruit unless conditions are such as will ensure a strong growth of plant. Frequent renewal of branches makes it possible to overcome the borer. The cuttings should be allowed to retain all the buds; this establishes a stooling habit—that is, shoots are pushed up from below the surface of the soil, and these take the place of old branches that are becoming infested with borers. Fruit is borne on wood of the previous season's growth as well as on spurs on older wood. On this account pruning is quite different from that for the red currant, more nearly approximating to that for the gooseberry as now practised. In former times both the gooseberry and the black currant were spur-pruned, and it was adherence to that practice that caused many growers in this country to abandon the culture of black currants. I am aware of only two varieties that have proved uniformly good—Carter's Black Champion and Kentish Hero. Currants and gooseberries should be planted 5 ft. apart each way.

Strawberries.—In many places autumn planting is practised, and this is already done. Spring planting is yet of the future. Where new land is to be planted the ground should be in course of preparation. Where the land is in grass-sod there is choice of two courses of procedure. One is to plough shallow and allow the turf to decay, then plough deep in spring so as to bury the disintegrated turf. The other is to plough deep now and shallow in spring. The former plan has the advantage of securing a greater degree of disintegration of the turf, which is a great advantage. The latter plan is best if the soil holds water near the surface. Old plants that are to be kept should have the foliage cut off, which should be removed and burned, or if it will dry sufficiently it may be burned where it lies, this being often done where there is leaf-spot infection. Some straw or dry pine-needles will help the burn. After cutting the foliage the plants should be sprayed with 4–4–40 bordeaux mixture.

Cape Gooseberries.—The seed may be sown in boxes under glass. When large enough to handle, prick off into other boxes, and keep the plants in shelter till spring frosts are past.

Garton Oats at Weraroa.—A crop of Garton oats at the Central Development Farm threshed out 84 bushels per acre last month. Algerian oats, also Black Tartars, lodged very badly during the season and suffered much during harvest, but the Gartons, although a heavier crop, remained standing throughout.

Local Demonstration Farms.—The committee of the Stratford Model Dairy Farm recently paid a visit to the Waimate West Demonstration Area, near Manaia, and were met by the local committee. After an inspection of the area—crops, top-dressed paddocks, milking-shed, &c.—some time was spent in exchanging views on farm matters concerning both districts. Such visits should be of distinct mutual benefit.

A RECENT STREET-WINDOW DISPLAY OF NEW ZEALAND WOOL AND WOOLLENS AT THE OFFICE OF THE HIGH COMMISSIONER, LONDON.
Model of shearing-shed in centre made by New Zealand soldiers.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions correspondents must give their name and address, not necessarily for publication but as a guarantee of good faith. Letters should be addressed to the Editor.

COW WITH SEROUS ABSCESS ON KNEE.

"SUBSCRIBER," Howick:—

I have a cow suffering from an enlargement of the knee, the size of a man's closed hand. It feels quite soft to touch as if full of water or air. The swelling does not seem to affect the animal's general health, but causes it to go lame when it moves quickly. The cow may give labor on the concrete floor of a feed-shed. Can you tell me of a cure for this trouble?

The Live-stock Division:—

The swelling described is fairly common among cattle. The enlargement is due to a collection of straw-coloured fluid underneath the skin of the knee, and is known as a serous abscess. It is due to some injury, and may have been caused, as you suggest, by the animal rising on the concrete, or by lying on hard ground or pavement. In the latter case the injury is received when the animal is getting up, as for the time the whole weight of the body is thrown on the knees. The swelling is best treated by opening the abscess and allowing the fluid to escape, after which the opening should be plugged with a piece of antiseptic dressing and bandaged. A quantity of permanganate of potash should be dissolved in a bucket of water, and the dressing allowed to remain in this for a day or two in the operator. When it should be removed and the opening allowed to heal. The opening should be made on one or other side, so that the animal will not injure the wound when getting up and down.

RENOVATING A PASPALUM-PADDOCK.

J. O'SULLIVAN, Manawaru:—

Kindly advise regarding the best means of renovating an old paspalum-paddock without ploughing it up. The ground is fairly light.

The Fields Instruction Branch:—

Previous to carrying out this work the pasture should be fed down as hard as possible. After this has been done the tine harrows may be employed. Give an additional seeding of 4 lb. paspalum and 2 lb. white clover to the acre, and roll down with the Cambridge roller. Then close the paddock up for a time to recover.

MARROWS AND PUMPKINS FOR STORING.

"SUBSCRIBER," Pihama:—

Could you tell me how vegetable marrows and pumpkins may be kept through the winter? Last year I had a good crop, which I pulled in May and put away in a dry shed. In about six weeks most of them went rotten.

The Horticulture Division:—

The keeping of marrows and pumpkins depends on their having reached a certain degree of ripeness. If allowed to ripen on the vine they will keep several years, but in that condition the thickness of flesh has considerably more than is desirable. If gathered when the rind is sufficiently hardened to make it difficult to pierce it with a thumb-nail they will keep nearly through winter. A little beyond that state of ripeness is safer for long keeping. It is a common practice to store late-grown fruits, but these rarely keep, as they have not had sufficient sun-heat to ripen them. Briefly, fruits for keeping should be saved from the main crop, not the last end—and they should not be knocked about and bruised in handling.

GRANULAR VAGINITIS OF COWS.

L. C., New Plymouth :—

Kindly tell me the cause of cows constantly returning to the bull, and whether such disease has anything to do with these animals showing swelling and irritation at the rear after several periods of service. Can you recommend a remedy for this condition ?

The Live-stock Division :—

The trouble you describe is probably the result of granular vaginitis. Treatment consists in the daily washing out of the vagina with one of the following solutions—Lysol 1–80, Jeyes Fluid 1–60, Lawes Fluid 1–60, Izal 1–60—until all signs of inflammation have disappeared. The bull's sheath should also be washed out with one or other of the antiseptics mentioned. Under no circumstances whatsoever should the bull serving affected cows be allowed to serve other members of the same herd.

ERADICATING FERN ON ARABLE LAND.

A. H. HUNT, Dairy Flat :—

What is the best method of eradicating fern which has taken possession of a 6-acre field previously cultivated and cropped ? The soil is 4 ft. deep and of a loamy nature.

The Fields Instruction Branch :—

The plan generally adopted is to put the land into swedes, and to allow the crop to be eaten off by heavy cattle. The land should then be ploughed and sown with the following grass-mixture : Cocksfoot 15 lb., Italian rye-grass 7 lb., and cow-grass 5 lb., to the acre. Should the fern persist in growing after the first season the mower should be run over it now and again, and the land stocked with cattle in sufficient numbers to crush the fern out during the autumn months. For this purpose roots and hay could be carted on to the land, if necessary, so that the work be thoroughly completed.

WARTS ON COWS' TEATS.

"DAIRYMAN," Motupipi :—

One of my cows is greatly troubled with warts on her teats, and the condition seems to be spreading to the other animals of the herd. What is the quickest and most reliable cure ?

The Live-stock Division :—

A means which has been found to answer readily is to apply for several days with a sponge a strong solution of washing-soda. Another method which sometimes gives good results is to smear the teats at each milking with good olive-oil. Failing these means, the warts should be clipped off with a pair of sharp scissors, and a little caustic applied to stop any hæmorrhage.

HORSE-BEANS FOR BEE-FODDER.

S. C. SMITH, Patea :—

I should be glad of information as to the best variety and the growing of horse-beans for honey-production. In this district bees must be fed during November at least ½ ton of sugar per 100 colonies, notwithstanding the extent of the winter stores one leaves for them. Any plant yielding nectar in late October and November would be valuable here, and I would be pleased to have advice regarding the matter.

The Horticulture Division :—

For flowering during October and November the beans should be sown in June. Drill in rows 20 in. to 24 in. apart, at the rate of about 3 bushels per acre. Variety, the common horse-bean. Flowering at a time when flowers are scarce the plants should be valuable for bees, and the crop should prove profitable apart from the bee-fodder it supplies. It would be necessary, however, to plant several acres, or the quantity of bee-fodder would be negligible.

VARIETIES OF OATS FOR HORSE-FEEDING.

T. G., Hauraki :—

Would you kindly advise me as to which is the best species of oat, the coarse (as Sparrowbill), or the fine (as Dun), to feed to horses, with particular reference to horses in training ?

The Live-stock Division :—

When fed whole, Dun oats are usually preferred to Sparrowbills on account of the finer shell of the former making them easier to masticate and digest. We are of opinion that there is little, if any, difference in the relative feeding-value when both are used in a crushed condition.

HARVESTING FIELD-PEAS.

"Subscriber," Tiakitahuna :—

This year I have grown some peas and vetches, and although using a pea-harvester attached to the mowing-machine I have experienced a difficulty in harvesting the crops. The peas I could cut only one way, and in the case of the vetches the machine got choked, very often after going only a few yards. I would be pleased if you could give me any information which would enable me to overcome these diff culties.

The Fields Instruction Branch :—

Where the mowing-machine fails to do good work an ordinary one-horse hay-rake will be found a most useful implement for harvesting field-peas. The crop usually lies in one direction, and by walking the horse on the edge of the crop about half the rake will drag the crop out satisfactorily. On the return journey the other half of the rake will act in a similar manner. This method, of course, necessitates another hand to move the dumps out of the way, which may be a disadvantage ; but the plan has been proved to be one of the most satisfactory. The same method should apply to vetches when sown alone, but if sown with 1 to 1½ bushels of oats the latter will usually hold the crop up sufficiently to allow the mowing-machine to be used.

FORMALIN TREATMENT FOR SEED-POTATOES.

W. V. G., Te Puke :—

Is the practice of dipping seed-potatoes in a solution of formalin and water to be recommended ? If so, what quantities are used ? Would this treatment be injurious to the crop ?

The Horticulture Division :—

Formalin treatment is recommended for seed-tubers affected by scab (*Oospora scabies*). It has no effect on other potato-diseases. The tubers should be left two hours in a solution composed of 1 pint of formalin to 30 gallons of water. The treatment is not injurious to the crop.

CROSSING BREEDS OF FOWLS.

"Inquirer," Picton :—

I have Leghorn and Black Minorca fowls, and wish to cross them with a heavier breed. What breed do you recommend me to try ?

The Chief Poultry Instructor :—

I would recommend you to mate a White Leghorn male with Black Orpington or White Plymouth Rock females. A Minorca male mated with Black Orpington hens may also produce good dual-purpose birds. Your object in crossing is not stated, but from an egg-laying view it is preferable to keep breeds in a state of purity, especially when it is intended to breed from the progeny likely to be produced.

FEEDING OF BREEDING-SOWS.

A. FLETCHER, Te Pahu :—

We are running a number of breeding-sows in 10-acre fern-paddocks, and having just weaned their litters they are a bit low in condition. They will not touch soft turnips, and the mangolds are not quite fit to pit. Would it do any harm to thin out mangolds and feed them tops and roots together, as the pigs seem to relish them ?

The Live-stock Division :—

It will not do the sows any harm to feed mangolds provided they are pulled and allowed to dry for at least one week (the longer the better), as they are liable to cause scour. Seeing that the sows are low in condition after weaning it is advisable to get them back into fair condition as quickly as possible if you wish to get the best results next farrowing. It would be advisable to purchase some pig-meal, and feed it in conjunction with the mangolds. No difficulty will be found in getting the sows to eat turnips if fed with meal.

OPOSSUMS AND ORCHARDS.

G. R. JONES, Okoia :—

Can you inform me of any way of ridding my orchard of opossums ? Most of the fruitgrowers in this district are finding it impossible to get any fruit on account of these pests. They are not to be found in the daytime, but come out at night and strip the trees, breaking many of the branches.

The Horticulture Division :—

There appears to be no practicable method of getting rid of opossums but to trap or shoot them in their haunts. Before doing this it would be necessary to ascertain if the animals are protected in your district. Opossums appear to cause very little trouble to fruitgrowers in their native country. They doubtless do some damage in isolated cases, but an extensive search in Australian fruit-growing publications failed to discover any reference to them.

FORTHCOMING WINTER SHOWS.

Otago A. and P. Society: Dunedin, 1st to 4th June.

Waikato Winter Show Association: Hamilton, 1st to 5th June.

Manawatu and West Coast A. and P. Association: Palmerston North, 22nd to 25th June.

(A. and P. Association secretaries are invited to supply dates and location of their shows.)

Meat-freezing Works in New Zealand.—Dissecting the list printed on page 336 into the two main divisions of the Dominion the following results are obtained:—Beef-killing capacity per day—North Island, 3,465 (86·19 per cent. of total); South Island, 555 (13·81 per cent.). Sheep-killing capacity per day—North Island, 81,600 (61·75 per cent.); South Island, 50,550 (38·25 per cent.). Cold-storage capacity in 60lb. mutton carcases—North Island, 5,089,656 (65·94 per cent.); South Island, 2,628,711 (34·06 per cent.).

Introduction of Bones from Fiji.—The regulations under the Stock Act for the prevention of the introduction into New Zealand of diseases affecting stock, including provisions prohibiting the importation of animal manures except from certain countries and under certain conditions, have been amended to permit of the introduction of bones from Fiji. The new regulations, setting forth the conditions under which such importations may be made, were gazetted on 15th April, and came into force on the same date.

MAXIMUM PRICES OF FLOUR, BRAN, AND POLLARD.

AN Order in Council dated 12th April, 1920, fixes the maximum prices in New Zealand of flour, bran, and pollard respectively, previous Orders on the same subject being simultaneously revoked. The schedules dealing with the products in question are as follows :—

II. FLOUR.

1. When the nearest port is Lyttelton, Timaru, or Oamaru, the maximum price of flour as sold by the manufacturer for delivery free on board at the nearest port, in 200 lb. sacks, on the terms of payment within seven days after delivery, shall be £16 10s. per ton, less 2½ per cent. ; and in the case of sale by the manufacturer otherwise than in manner aforesaid the maximum price shall be a price equivalent, as regards the seller, to the maximum price above mentioned.

2. In this schedule the term "nearest port" means the port of entry under the Customs Act, 1913, which is nearest to or includes the place of manufacture of the flour sold.

3. When the nearest port is a port other than Lyttelton, Timaru, or Oamaru, the maximum price of flour as sold by the manufacturer for delivery free on board at the nearest port, in 200 lb. sacks, on the terms of payment within seven days after delivery, shall be £16 10s. per ton, less 2½ per cent. ; with such addition only as is equal to the cost of the carriage by sea of a ton of flour from Lyttelton, Timaru, or Oamaru (whichever cost is the least) to the said nearest port ; and in the case of sale by the manufacturer otherwise than in the manner aforesaid the maximum price shall be the price equivalent, as regards the seller, to the maximum price last above mentioned.

III. BRAN AND POLLARD.

1. When the nearest port is Lyttelton, Timaru, or Oamaru, the maximum price of bran and pollard as sold by the manufacturer for delivery free on board at the nearest port, on the terms of payment within seven days after delivery, shall be £7 per ton in the case of bran and £9 per ton in the case of pollard, less in each case 2½ per cent. ; and in the case of sale by the manufacturer otherwise than in the manner aforesaid the maximum price shall be a price equivalent, as regards the seller, to the maximum prices above mentioned.

2. In this schedule the term "nearest port" means the port of entry under the Customs Act, 1913, which is nearest to or includes the place of manufacture of the bran or pollard sold.

3. When the nearest port is a port other than Lyttelton, Timaru, or Oamaru, the maximum price of bran or pollard as sold by the manufacturer for delivery free on board at the nearest port, on the terms of payment within seven days after delivery, shall be £7 per ton in the case of bran and £9 per ton in the case of pollard, less in each case 2½ per cent., with such addition only as is equal to the cost of carriage by sea of a ton of bran or pollard, as the case may be, from Lyttelton, Timaru, or Oamaru (whichever cost is the least) to the said nearest port ; and in the case of sale by the manufacturer otherwise than in the manner aforesaid the maximum price shall be a price equivalent, as regards the seller, to the maximum price last above mentioned.

IV. SALE OF BRAN OR POLLARD OTHER THAN BY THE MANUFACTURER.

When bran or pollard manufactured in New Zealand is sold to a purchaser by any person other than the manufacturer thereof, the maximum price thereof shall be the maximum price as set out in the Second Schedule hereto, with such addition only to that maximum price as is herein specified, namely : (*a*) When sold in a quantity of half a ton or more, an addition at the rate of 10s. per ton in the case of bran and 15s. per ton in the case of pollard ; (*b*) when sold in a quantity less than half a ton, an addition at the rate of 12s. 6d. per ton in the case of bran and 17s. 6d. per ton in the case of pollard.

V. GENERAL RESERVATIONS.

1. Notwithstanding anything in this Order in Council, the New Zealand Board of Trade may, by order made by it, authorize the sale of flour, bran, or pollard in any specified locality, or by any specified seller, at a price exceeding the maximum price fixed by the Second, Third, and Fourth Schedules hereto by such amount

as the Board thinks fit; and nothing in this Order in Council shall apply to the sale of flour, bran, or pollard in accordance with the authority so granted by the Board of Trade.

2. Any such authority may be at any time withdrawn by the Board of Trade by order made by it.

PHYLLOXERA VASTATRIX.

NOTICE TO VITICULTURISTS.

THE following circular has been issued by the Director of the Horticulture Division:—

A recent inspection of the vines in the districts round Auckland has revealed the presence of phylloxera in a number of places. This has arisen from a want of appreciation on the part of the vine-growers of the warnings given by this branch of the Department from time to time since 1885 that phylloxera was present in the Dominion and a danger to vine-growing. The most practical effort in providing means of control was the establishment, by the Department, of the viticultural branch of horticulture at the Arataki Horticultural Station, Havelock North, Hawke's Bay, where the leading varieties of phylloxera-resistant stocks have been propagated since 1903, and many varieties of wine and table varieties grafted on them. These have been on sale to growers at much less than cost price. Some of the leading nurserymen also are now supplying vines on resistant roots. The object of this circular is to again warn all vine-growers of the danger to successful viticulture of growing any vines from cuttings—the phylloxera-resistant stock vines excepted. The present state of some of the vineyards is a proof that the non-use of resistant stocks is only inviting future trouble.

In the raising of vines worked in this way it is very necessary to see that after a season's growth the scion is not sending down roots, which it may do where the plant is put in deep enough for the union of scion and stock to come in contact with the soil. This may occur at any time should the soil be brought up to the scion. In the winter when pruning and in spring when disbudding are the times to note whether such is taking place or not. Where it is found to have occurred the roots should be cut clean away and the soil removed from where they have started, sufficiently to prevent a recurrence.

Seeing that the raising of resistant stocks and propagation of the many kinds of wine and table grapes has been carried on by the Department at great expense for the benefit of the viticultural industry, and to avoid unnecessary expenditure of money and labour in raising stock for which there might not be a demand, orders for vines must be received by the Manager of the Arataki Station during the winter months. The varieties for which orders are given will then be grafted in spring, and the plants supplied to the grower during the following winter—that is, twelve months after receiving the order. There is at present a stock of resistant one-year-old plants ready for grafting at the Arataki Station. Orders received this winter can therefore be supplied in the winter of 1921.

Although phylloxera is general in many of the vine-growing districts, it has been decided, in the interests of vine-growers, to allow them to retain those now bearing fruit for another two seasons—namely, till the planting season of July, 1922. After that date all phylloxera-affected vines must be rooted out and burned.

Applications for the purchase of phylloxera-resistant stocks (rootlings) or for grape-vines are to be made to the Manager, Arataki Horticultural Station, Havelock North, Hawke's Bay. Orders are filled in rotation of application. Payment must accompany all orders. The price of one-year-old grafted vines is £4 per hundred. For lots of fifty and over at the same rate, *pro rata*, as per hundred. For lots under fifty, 1s. per plant. For resistant stocks (rootlings) the price is 15s. per hundred, or £3 per thousand. All orders put on train at Hastings.

Introduction of Stock into Fiji.—Consolidated regulations relating to the introduction of stock into Fiji were recently issued by the Administration of that colony. The full text of the regulations was published for general information in the *New Zealand Gazette* of 8th April, 1920.

MEAT-FREEZING WORKS IN NEW ZEALAND.

Name and Address of Company. *Land District.*	Location of Works.	Beef-killing Capacity per Day.	Sheep-killing Capacity per Day.	Storage Capacity, in 60 lb. Carcases Mutton.
Auckland.				
Whangarei Freezing Company, Ltd., Auckland ..	Whangarei Hds.	150	1,000	80,000
Auckland Farmers' Freezing Company, Ltd., Auckland	Southdown ..	200	3,000	215,000
,, ,, ,, ,,	Horotiu ..	200	3,000	218,000
Westfield Freezing Company, Ltd., Auckland ..	Westfield ..	200	3,000	225,000
R. and W. Hellaby, Ltd., Auckland	,, ..	120	500	5,000
East Coast Co-op. Freezing Company, Ltd., Whakatane	Whakatane ..	200	1,000	140,000
Hawke's Bay.				
Wairoa Farmers' Co-operative Meat Co., Ltd., Wairoa	Wairoa ..	50	2,000	165,000
North British and Hawke's Bay Freezing Company, Ltd., Napier	Westshore ..	40	1,500	36,000
Thomas Borthwick & Sons (Aus.), Ltd., Christchurch ..	Pakipaki ..	30	1,500	71,000
Nelson Bros., Ltd., Tomoana	Tomoana ..	80	3,000	175,000
Hawke's Bay Farmers' Meat Company, Ltd., Hastings	Whakatu ..	80	2,000	155,000
Tokomaru Sheep-farmers' Freezing Company, Ltd. ..	Tokomaru Bay	45	2,500	140,000
Poverty Bay Farmers' Meat Company, Ltd., Gisborne	Kaiteratahi ..	100	2,000	300,000
Gisborne Sheep-farmers' Frozen Meat Company, Ltd., Gisborne	Kaiti ..	150	6,000	426,122
Nelson Bros., Ltd., Gisborne	Taruheru ..	85	2,500	100,000
Taranaki.				
Taranaki Farmers' Meat Company, Ltd., New Plymouth	Smart Road ..	100	2,000	135,000
Thomas Borthwick & Sons (Aus.), Ltd., Christchurch ..	Waitara ..	200	2,000	100,000
New Zealand Meat Packing and Bacon Company (Co-operative), Ltd., Wellington	Eltham ..	75	..	25,000
Patea Farmers' Co-op. Freezing Company, Ltd., Patea	Patea ..	120	1,000	180,000
Wellington.				
Wanganui Meat-freezing Company, Ltd., Wanganui ..	Castlecliff ..	100	2,200	160,000
New Zealand Refrigerating Company, Ltd., Christchurch	Imlay ..	200	6,000	271,000
Otaihape Farmers' Meat Company, Ltd., Taihape ..	Winiata ..	50	1,200	125,000
Feilding Farmers' Freezing Company, Ltd., Feilding ..	Aorangi ..	100	2,200	223,534
National Mortgage and Agency Company of New Zealand, Ltd., Dunedin	Longburn ..	60	1,500	165,000
Wellington Farmers' Meat Company, Ltd., Masterton	Waingawa ..	250	6,000	353,000
Gear Meat Preserving and Freezing Company, Ltd., Wellington	Petone ..	100	10,000	415,000
Wellington Meat Export Company, Ltd., Wellington ..	Ngahauranga ..	120	8,000	260,000
,, ,, ,, ..	Kakariki ..	100	2,000	126,000
New Zealand Meat Packing and Bacon Company (Co-operative), Ltd., Wellington	Ngahauranga ..	160	3,000	100,000
Marlborough.				
New Zealand Refrigerating Co., Ltd., Christchurch ..	Picton ..	30	1,000	23,000
Nelson.				
Nelson Freezing Company, Ltd., Nelson	Stoke ..	..	350	40,000
Canterbury.				
Canterbury Frozen Meat Company, Ltd., Christchurch	Belfast ..	50	7,000	190,000
,, ,, ,,	Fairfield ..	..	4,000	80,000
,, ,, ,,	Pareora ..	25	4,500	230,000
New Zealand Refrigerating Co., Ltd., Christchurch ..	Islington ..	50	7,000	375,000
,, ,, ,, ..	Smithfield ..	50	6,000	266,000
North Canterbury Sheep-farmers' Co-operative Freezing Company, Ltd., Christchurch	Kaiapoi ..	50	2,500	259,000
Thomas Borthwick & Sons (Aus.), Ltd., Christchurch ..	Belfast ..	..	4,000	126,000
Otago.				
New Zealand Refrigerating Co., Ltd., Christchurch ..	Pukeuri ..	..	3,000	230,000
,, ,, ,, ..	Burnside ..	50	3,500	216,000
South Otago Freezing Company, Ltd., Balclutha ..	Finegand ..	30	1,200	200,000
Southland.				
Birt and Co., Ltd., Invercargill	Ocean Beach ..	100	2,500	114,000
Southland Frozen Meat Company, Ltd., Invercargill ..	Mataura ..	50	2,000	91,459
,, ,, ,, ..	Makarewa ..	70	2,000	73,974
,, ,, ,, ..	Bluff ..	..	..	114,278
Total	..	4,020	132,150	7,718,367